

Compressed Air

Magazine

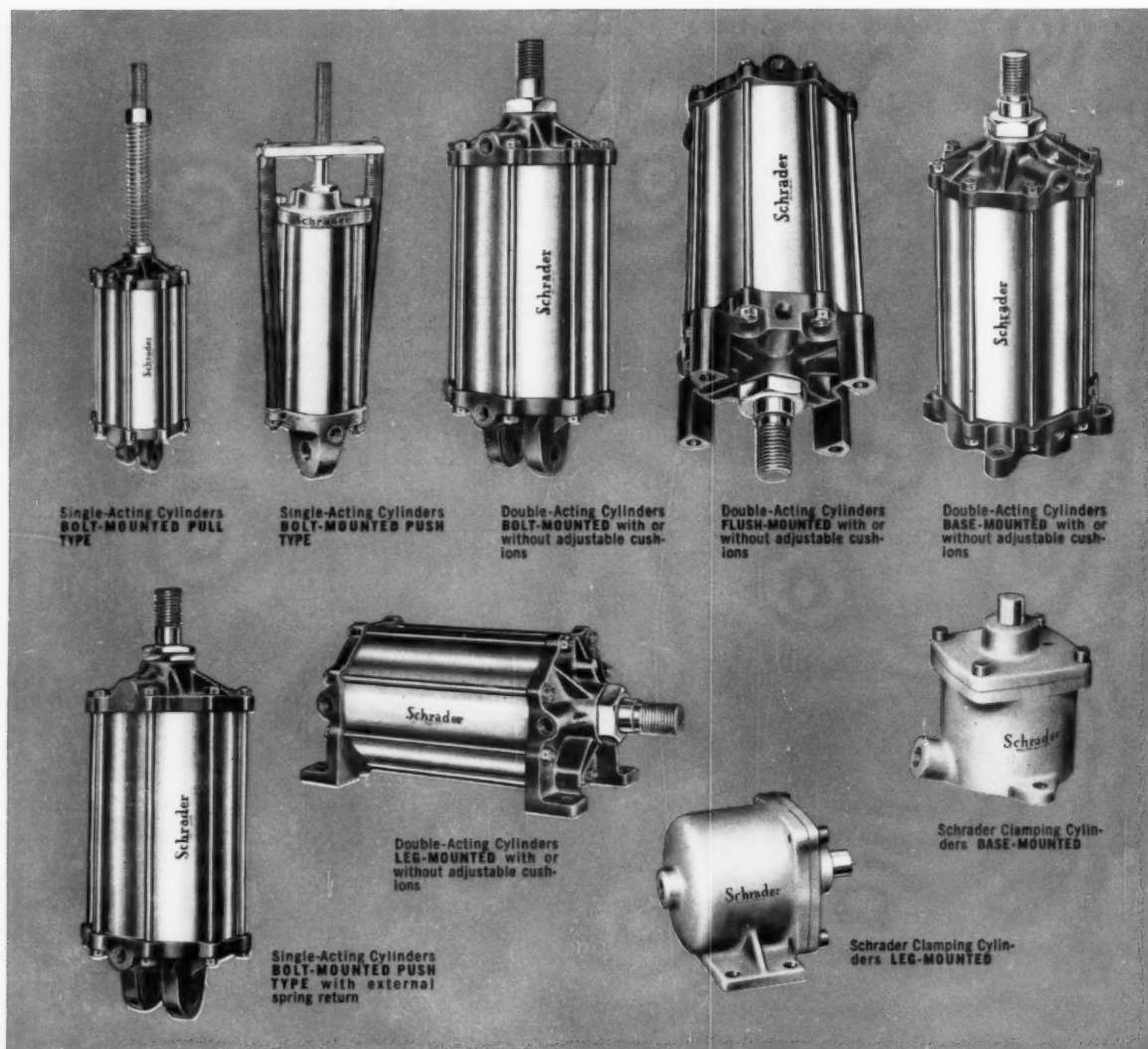


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AUGUST 1958

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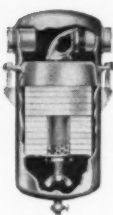
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Pipe Line Filter
Bulletin 200



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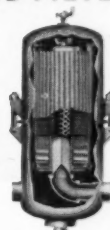


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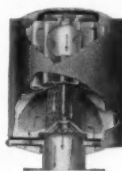
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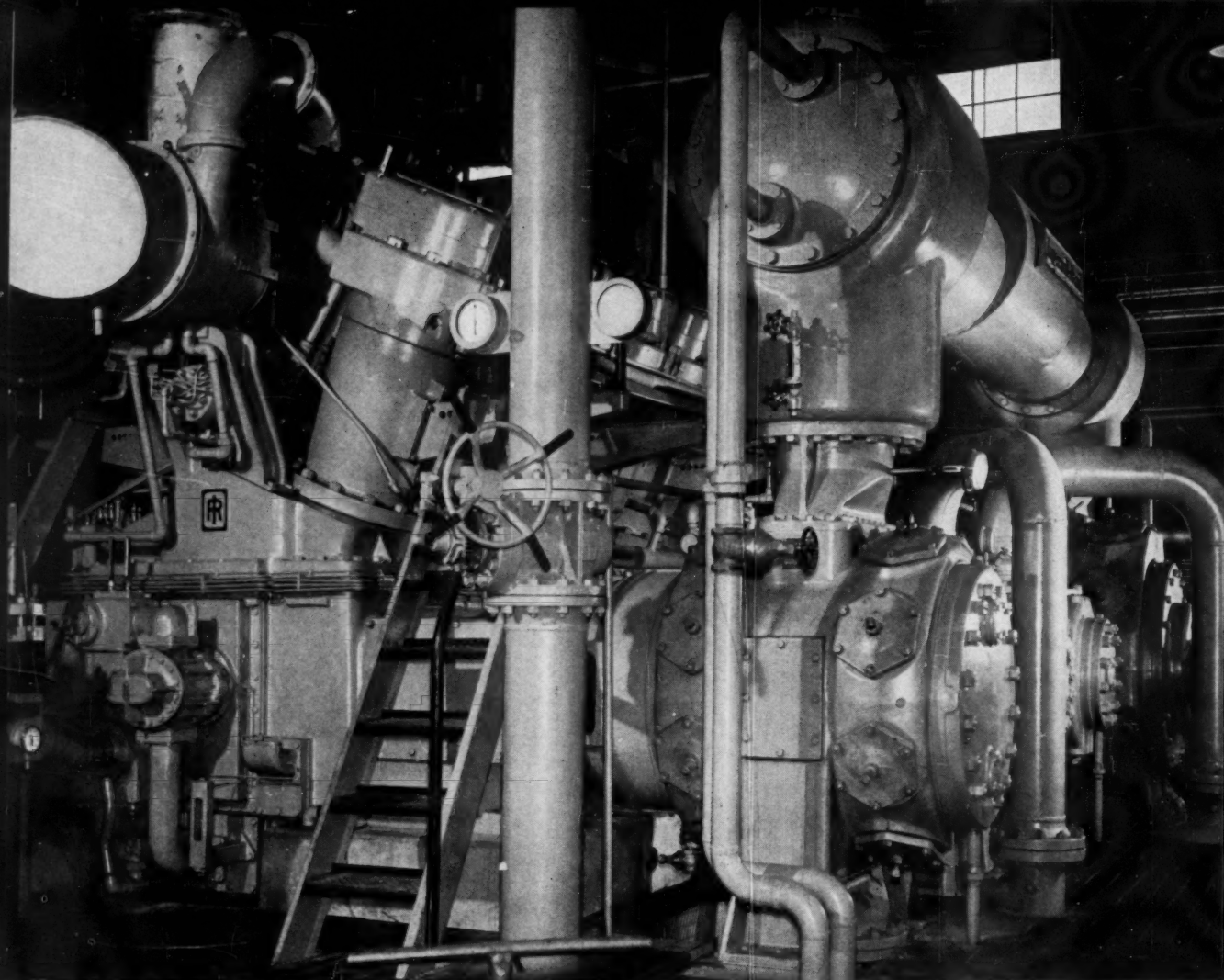
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Compressed Air Magazine

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ON THE COVER

TO TAP a rich coal field, the Norfolk & Western Railway has driven an 8240-foot-long tunnel through Sandy Ridge in the Virginia mountains. The scene on the cover, photographed at the start of construction, shows the earth-and-rock cut leading to the south portal of the new single-track bore. Holed through on May 16, the tunnel is now open for limited traffic and is being concreted.

FEATURE ARTICLES

Page 10 Tunnel To Tap A Coal Field—*R. J. Nemmers*

To bring efficient transportation to a new coal field, the Norfolk & Western Railway Company is building a 6.3-mile-long extension to its Wilder Spur. A 1.56-mile, 27x20-foot-horseshoe bore is part of the work. Two 9-drill jumbos pounded out blast holes in the tunnel headings.

14 Smog, Part 1—*C. H. Vivian*

Los Angeles is doing something about its smog condition. This first part of a 2-part story tells of some of the correction efforts that are being made, gives an indication of its cost, tells what smog is and gives a brief glimpse of its long history.

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Louisiana is the site of a 3655-foot-long, all-bolted steel bridge. Maintaining consistent torques helped meet design specifications.

21 Air Cushion Aids Submarine Drilling

Founded on a basic principle of blasting techniques, this unique device is speeding work on one phase of the St. Lawrence Seaway.

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A versatile device for relieving materials-handling bottlenecks often found in production and fabrication is described.

24 Improved Quality And Increased Quantity

By spraying spray glue, a manufacturer has increased its production of cabinets.

25 Pioneer Days Of Marble Quarrying In Tennessee — *Paul Ziemke*

Marble has been one of this state's principal resources since the eighteenth century.

26 Raising The Roof With Air Power

Unconventional mobile homes can be erected in minutes.

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Air power shakes down dump trailer trucks.

30 Twenty Years Without Maintenance

A receiver-mounted compressor is still on the job.

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G. W. Morrison, *Publisher*

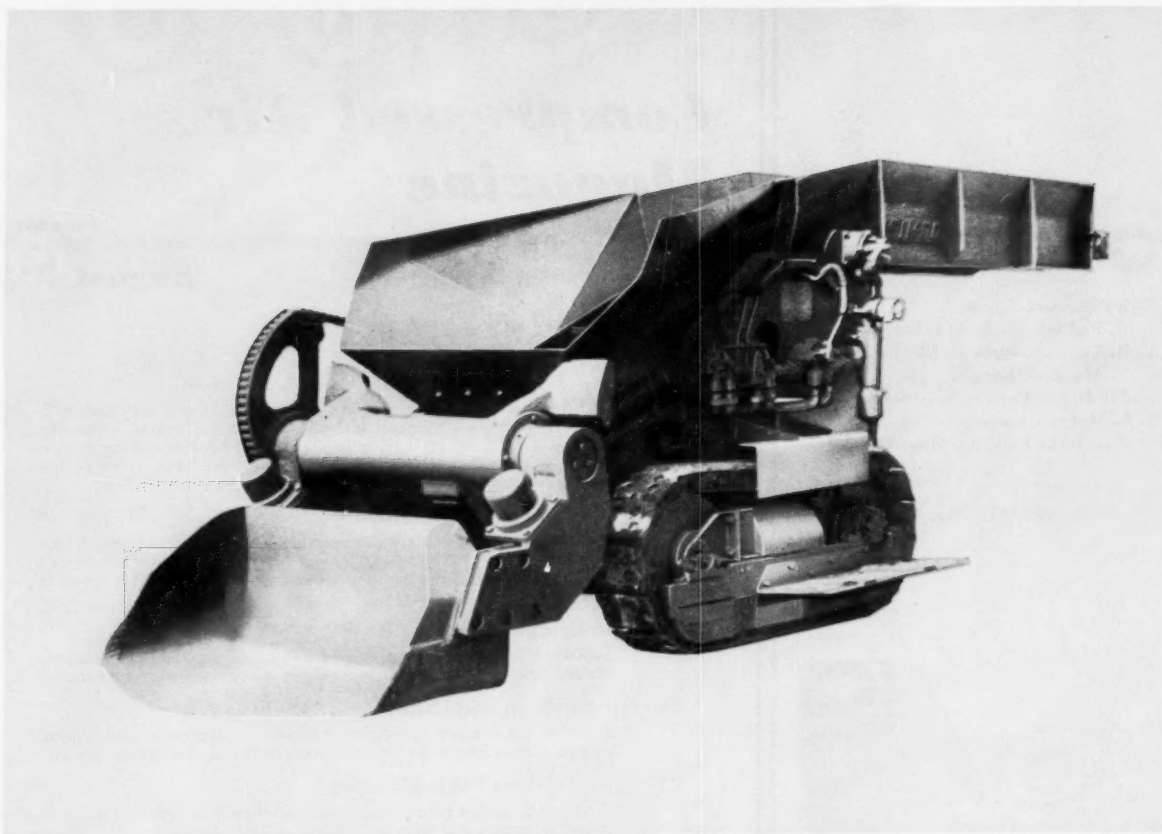
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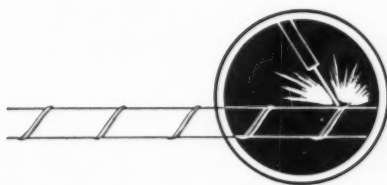
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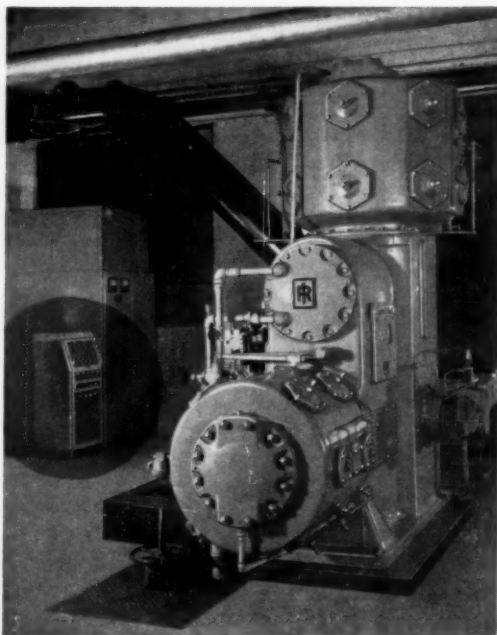


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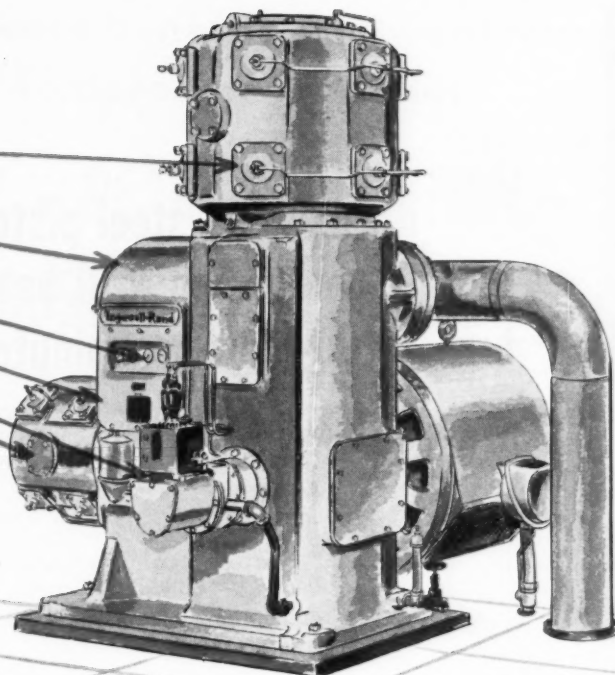
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New *'Tendomatic* control
the tireless attendant
brings
automatic supervision
to the
COMPRESSOR PLANT

(left) 'Tendomatic control of this two-stage heavy-duty air compressor, an Ingersoll-Rand type XLE packaged unit with built-in motor, assures maximum protection of capital investment, maximum manpower utilization, continuity of production and lower maintenance expense.



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in time to take corrective measures. If the warning is ignored or forgotten, 'Tendamatic' shuts down the compressor before any damage results. If oil pressure fails or if any vibration occurs, it stops the machine *at once* without advance warning.

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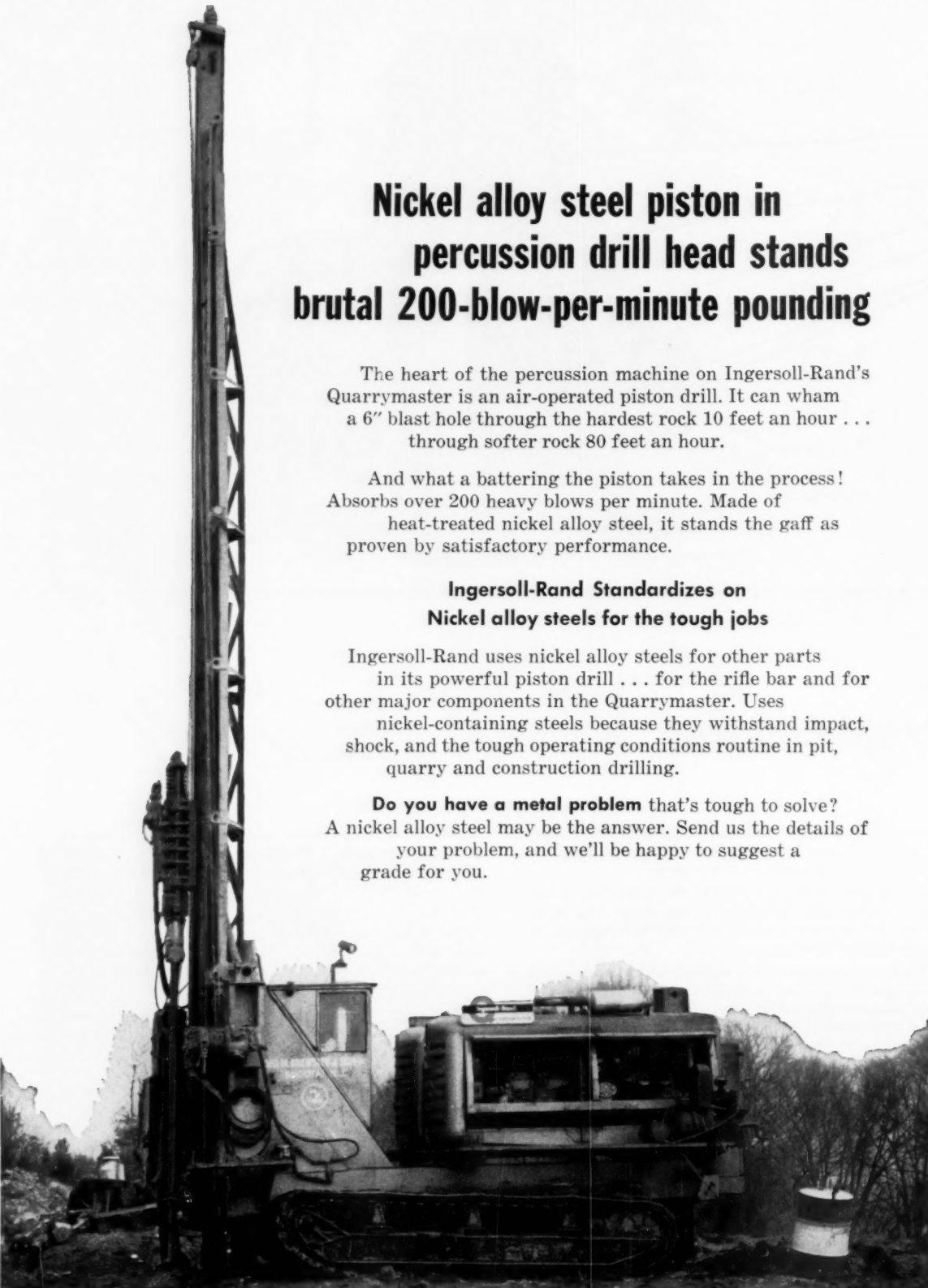
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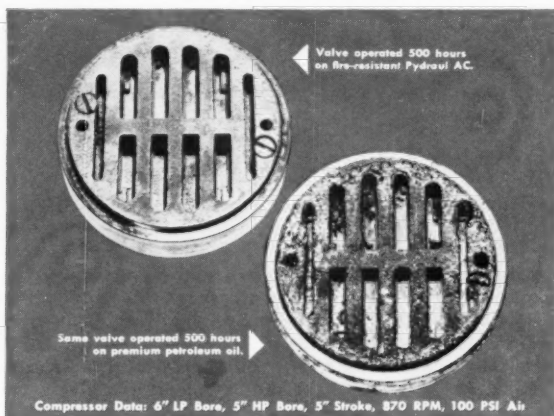
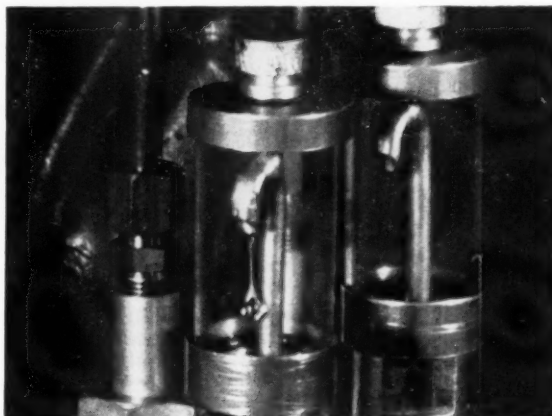
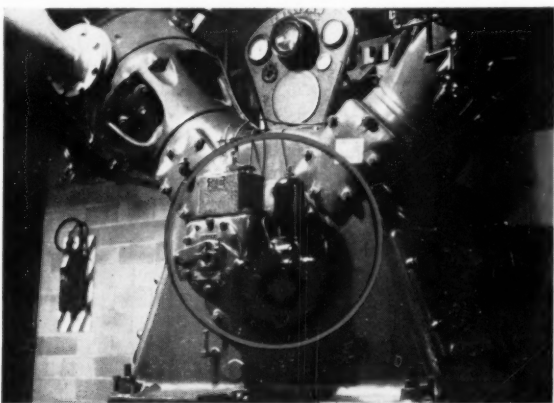


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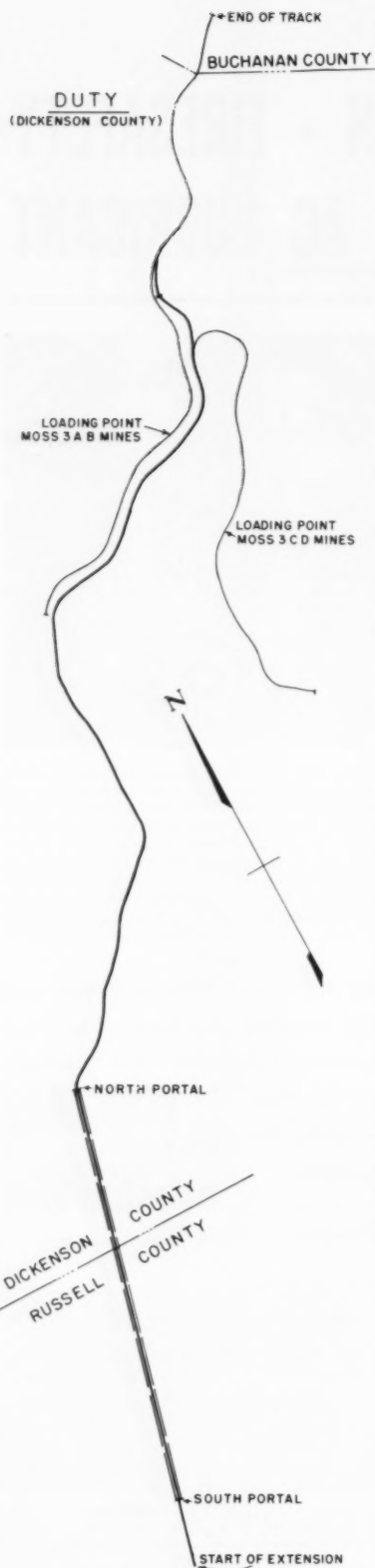
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The Norfolk & Western Railway Is Completing
An 8240-Foot-Long Single-Track—

Tunnel To Tap A Coal Field

R. J. Nemmers

VIRGINIA'S mineral resources are abundant and varied, but perhaps the most actively worked are the coal beds of the Allegheny range. In Tazewell County, for example, is the famous Pocahontas seam which, for years, has produced one of the highest grades of metallurgical and coking coal to be found in the United States.

In nearby Dickinson County, not far from the Pocahontas seam operations, Clinchfield Coal Company, Division of The Pittston Company, is developing a rich seam of 15-foot maximum thickness. The coal seam covers a wide area in Dickinson and Russell counties. The new mine, which will begin operations upon completion of a new Norfolk & Western spur line, has been named Moss No. 3 Mine and will produce an excellent metallurgical and coking coal. Clinchfield estimates reserves in this seam at more than 140 million tons. Initial production from the mine will be 3,000,000 tons a year. The coal producer has a firm contract for the delivery of some 1.3 million tons a year

to a new 450,000-kw power plant being erected at Carbo, Va., by Appalachian Power Company, an operating subsidiary of American Electric Power Company (formerly American Gas & Electric Company).

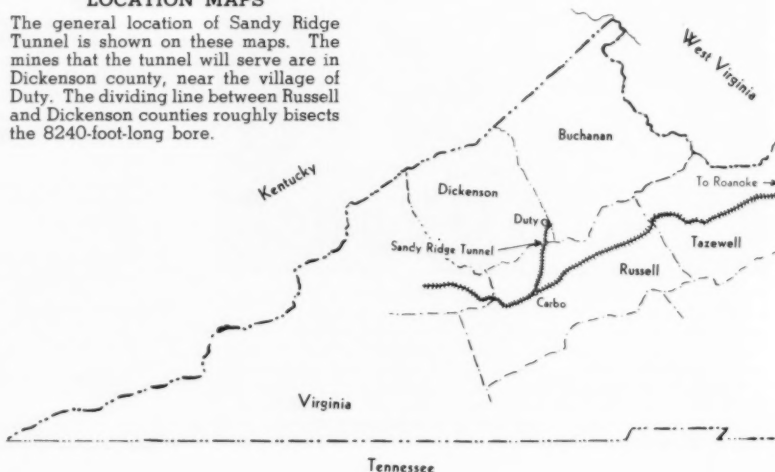
To carry this coal to market, the Norfolk & Western Railway is constructing a 6.3-mile extension to its Wilder Spur, including an 8240-foot-long, single-track tunnel. In addition operation tracks for two coal-loading points and a large coal-preparation plant near Carbo are being laid.

The bore penetrates Sandy Ridge Mountain, with a summit elevation of 2730 feet over the tunnel, on the south edge of the valley in which the coal will be loaded. The valley is largely inaccessible, being served, prior to the construction of the spur, by only two secondary state routes, neither of which has been hard surfaced. The terrain is rugged in all respects.

The existing portion of Wilder Spur, from its connection with the N&W Dumps Creek Branch near the mouth

LOCATION MAPS

The general location of Sandy Ridge Tunnel is shown on these maps. The mines that the tunnel will serve are in Dickinson county, near the village of Duty. The dividing line between Russell and Dickinson counties roughly bisects the 8240-foot-long bore.





NORTH PORTAL

Cut for a distance of some 2400 feet through overburden of up to 100 feet in thickness, the approach to the north portal is on a 12-degree, 30-minute curve and slopes away from a point just outside the portal on a 2.1 percent compensated grade. In the foreground is one of the Koehring Dumpsters and one of the Eimco 105 muckers.

At the right is the new stream bed of Cane Creek that once passed far above the railroad subgrade. Leading into the bore can be seen the ventilating line (26-inch Naylor pipe), the 6-inch air line and the 2-inch water header. Axial-flow blowers were mounted in the ventilation line.

of Hurricane Fork, at Carbo, consists of 3.7 miles of single-track roadbed and serves two other Clinchfield coal operations. The extension of the Spur leads for some 1260 feet through an open cut to the south portal of the new bore on a grade of 1 percent. On entering the tunnel, at elevation 1927.1, the track assumes a grade of 0.25 percent, emerging at the north portal at elevation 1947.7. Almost immediately upon leaving the tunnel, the track strikes down into the valley on a winding 3.47-mile-long, 2.1-percent compensated grade. This portion includes a 2400-foot-long cut coming out of the hillside in which up to 100 feet of overlying earth and rock were removed from the right-of-way. Indeed, construction of the approach to the north portal of the bore was one of the toughest segments of the extension. Cane Creek, which flows down the side of the mountain, followed a stream bed some 65 feet above the extension and consequently had to be lowered to bring it to an elevation below the subgrade at the tunnel entrance. Furthermore, the diversion work on the creek had to be accomplished in stages as the cut was made.

At the end of the long, 2.1-percent grade, the track levels to a comparatively easy 0.5-percent stretch approximately 5000 feet in length, the end of the track lying at elevation 1563.4, or

about 375 feet below the north portal of Sandy Ridge Tunnel.

Two sets of operation tracks lead from the extension, both of them heading roughly to the south or opposite to the main-spur trackage. One of these, called the Tiller Fork Spur, leaves the extension at a point slightly more than 3 miles from the north portal. Serving Clinchfield Coal's Moss 3 C and D openings on the east side of the Wilder Spur extension, it departs on a 2.1-percent downgrade, dipping finally to an elevation of 1602 feet and then climbing to elevation 1743 at the dead end. Part of the 1.8-mile spur includes grades of up to 2.6 percent.

The other track, serving Moss 3 A and B portals on the west side of the extension, leaves about 0.5 mile farther downgrade and is approximately 1.7 miles in length. Its profile is equally as rugged as that of the Tiller Fork Spur, grades of minus 2.1 and plus 2.5 being encountered. Final elevation of the dead end on this operation trackage is 1668 feet; at its lowest elevation, the track is some 396 feet below the north portal of the bore.

The rugged terrain has presented many problems to the builders, but few of them have been unique to the Norfolk & Western which has been operating in the state since 1837 when it was begun in Petersburg as the City Point Rail-

road with about 9 miles of track. The carrier assumed its present name in 1881, at which time construction of lines into and through the mountainous regions of Virginia, West Virginia and Ohio began.

Of horseshoe section, the tunnel will have lined dimensions of 17 feet (at the springing line) by 23 feet 1 inch, measuring from the base of the rails to the roof line. The size of the bore as excavated is approximately 20x27 feet. The railroad estimates about 20 cubic yards of material have been removed for each linear foot of advance, or a total of more than 170,000 cubic yards for the bore. As might be expected, it was driven from both ends.

The rock conditions encountered during the driving of the tunnel made necessary the placement of 8-inch H-beam steel sets throughout all but about 600 feet of its length. These are placed on 3-, 3.5-, 4- and 6-foot centers, depending on conditions. The rock is composed primarily of gray sandstones, shale and coal seams, the latter varying from 6 to 42 inches in thickness. They have proved to be troublesome in many respects. In the south heading, a coal seam coincided with the roof line for most of the length and, of course, broke away with every blast, resulting in considerable overbreak and requiring heavy timber blocking above the steel sets. On the other hand, in the north heading,

a coal seam lay just below the floor line, requiring that additional ground be excavated, backfilled with rock and then grouted.

Sandy Ridge Tunnel is the longest railway tunnel ever built in Virginia, exceeding the N&W's famed Elkhorn tunnel in length by some 1100 feet; however, the Elkhorn is a double track opening. The Sandy Ridge bore was holed through at 5:20 pm, Friday, May 16, when the last 23 feet of rock was removed in one blast. (Appropriately enough, William Stapleton, Superintendent of the new Moss 3 Mine which the tunnel will serve, was one of the first men through the opening.)

The tunnel and open-cut work were performed by the Ralph E. Mills Company, Salem, Va., and were accomplished in record time. The first blast was fired at the south portal on July 3, 1957. At the north portal, the first shot was set off on September 27. When both headings were in operation and the crews had had a chance to get familiar with the ground, progress attained a weekly average of about 250 feet including steel setting. Work was carried on nearly

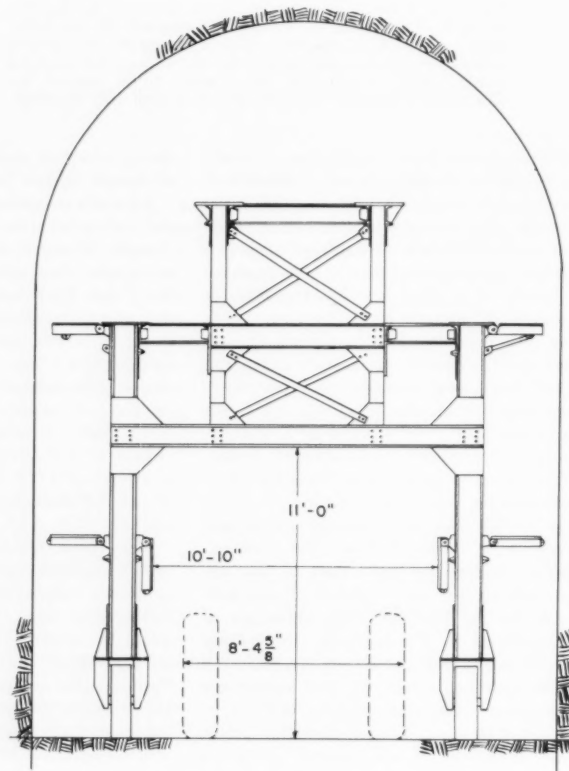
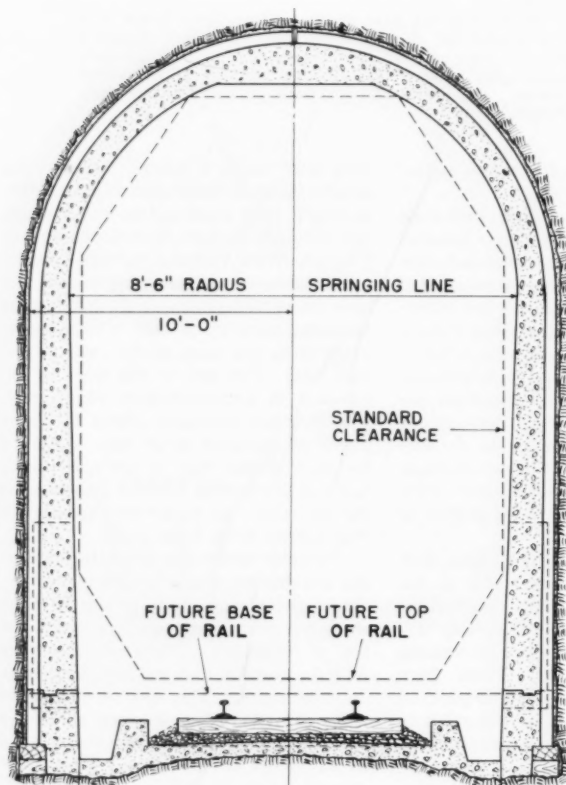
around the clock by two 10-hour shifts, working 6 days a week.

Drilling was done from two jumbos, each equipped with nine Ingersoll-Rand DB-35 drifters on HBJ2 Hydra-Booms. The drills were mounted on PF4 aluminum power-feed shells, 48 inches in length. Each of the jumbos had three drilling decks above the floor line. In the south portal, the rig measured some 31 feet in length; in the north portal, it was 4 feet longer. (A sketch of the end elevation of the jumbos is included in the illustrations below.)

Two different drill patterns were utilized, depending on ground conditions. One pulled approximately 8 feet and the other, 12. The latter was the more commonly used in later stages and called for the drilling of approximately 95 holes per round. Three steel changes were utilized on the peripheral holes (4-, 8-, and 12-foot lengths) and four changes on the 6 holes making up each of two wedge cuts. There was a 10-foot spread between the holes in the wedge cut, necessitating the use of a final 15-foot steel change to bottom the holes. Holes were collared at $1\frac{3}{4}$ inches and bottomed

at $1\frac{5}{8}$ inches utilizing tungsten-carbide-insert bits and $1\frac{1}{4}$ -inch steel. The average round required approximately $1\frac{1}{2}$ to 2 hours to drill out and another $\frac{3}{4}$ -hour period to load the holes. Approximately 550 pounds of 40-percent gelatin dynamite were utilized per round in $1\frac{1}{4}$ x8-inch cartridges. The powder was electrically fired with Atlas millisecond delay caps in periods from 0 to 10.

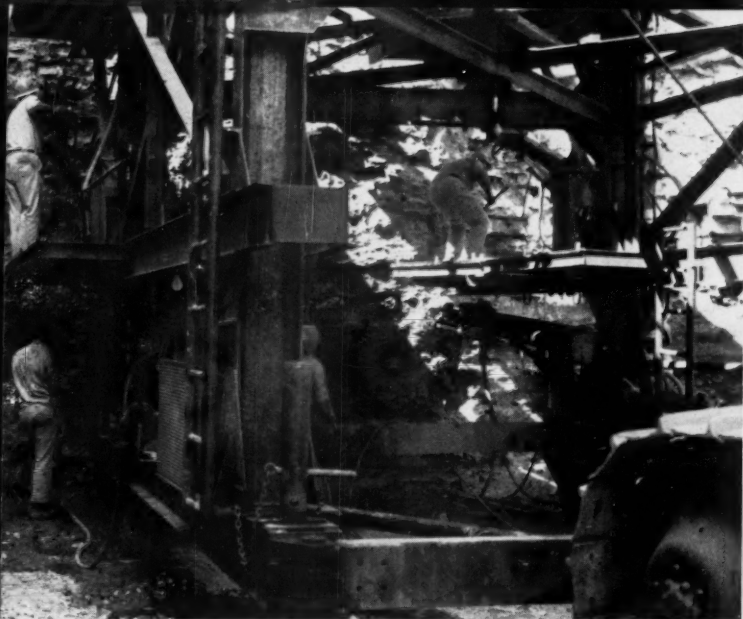
After blasting, which brought down approximately 240 yards of material in the case of a 12-foot round, the bore was mucked out utilizing an Eimco 105 diesel-powered, overshot mucker equipped with a 2-yard bucket. The Eimco loaded directly into Koehring Dumpsters which, at the south portal, made the run out of the tunnel, up an incline and there dumped through a chute directly into Euclid trucks for the haul to the disposal area. At the north portal, the Dumpsters hauled the muck to a dump pile at the end of the long cut leading to the portal. A Bucyrus-Erie 22-B shovel then loaded into Euclids for the remainder of the haul to the disposal area. It required about $2\frac{1}{2}$ to 3 hours to muck out after each blast.



SECTION VIEWS

The location of the rails as displayed in the section view of the tunnel is their placement while lining work is being carried on. Later, they will be raised and more heavily ballasted. The tunnel is to have lined dimensions as indicated, with a measurement of 23 feet 1 inch from the future base of the rail to the roof. The other sketch, of the jumbo, shows the placement of the drilling docks

and indicates the critical dimensions of the equipment pass through which the Dumpsters and muckers must work. Nine Ingersoll-Rand DB-35 drifters, carried on 48-inch aluminum power-feed shells and mounted on Hydra-Booms, were positioned on each of the two jumbos. The over-all height, from wheels to poop deck, is about 20 feet, and the units are 18 feet 8 inches wide with wings raised.



STARTING A TUNNEL AND A ROUND

In the picture at the left, the Mills crew is drilling the initial round of Sandy Ridge Tunnel. The heading was turned July 3, 1957. In the other picture, taken just at the start of drilling a new round, the Hydra-Boom-mounted Ingersoll-Rand DB-35 drifters shown are set up to drill the initial holes of the lower 6-hole wedge cut. The machine at the left is aimed at a point 12 feet into the rock

and on the center line. The drill in the center of the picture is aligned with the center line of the tunnel and will bottom its hole at approximately the same point. The miners at the right are handling a third drill aimed at that point. On the upper decks of the jumbo, four other drills are working on the top wedge cut, and at the bottom corners, two more are hammering out the corner lift holes.

After mucking, the jumbo was advanced and used for steel setting tasks. The poop deck on each jumbo mounted two Ingersoll-Rand pneumatic hoists, one, a model BU and the other, a model HU. In setting steel, the HU hoist, mounted on the front of the jumbo, swung the side beams into place. The BU unit, at the rear, handled the arches. The sets were founded on 6x12-inch hardwood blocking, were tied together by 1-inch steel rods and separated by 4x4-inch timbers, of proper length.

The concrete floor of the tunnel was laid by the contractor immediately after the cleaning up operations that followed holing through. Most of the concrete was brought in from a batching plant at the south portal, paving operations beginning at the north end. (A part of the concrete was furnished from a small batching plant at the north portal.) The Dumpsters used in mucking operations were equipped with Dumpcrete bodies to haul in the mix. Tracks were laid as soon as the concrete was cured, and the tunnel was opened for rail traffic about August 1. Lining of the remainder of the tunnel is being carried on under traffic.

Contractor work forces were supervised by J. M. Lipscomb, Managing Director for Ralph E. Mills Company. William Houston was tunnel superintendent at the north portal and Richard Bingham at the south. For the railroad, A. B. Stone is Chief Engineer, assisted by B. E. Crumpler. L. A. Durham, Jr., is division engineer for the Pocahontas Division, and C. W. Fiery and W. B. Cole are resident engineers for the N&W.



MUCKING OUT

The 2-yard bucket of one of the four Eimco 105 muckers used in the tunnel is just visible in this view. In the foreground is one of the Koehring Dumpsters used to haul spoil from the headings. It required an average 2 to 2½ hours to muck out the approximately 240 cubic yards of spoil from one 12-foot round.

Smog

How Los Angeles Is Coping With
A Plaguing Condition Caused
By An Aerial Pollution Trap
Called "Temperature Inversion"

Part 1

C. H. Vivian

COMPRESSORS are helping to combat the smog menace that has gripped the Los Angeles Basin for the past 10 years. Throughout the area's various branches of the important petroleum industry, scores of these machines play key roles in trapping and conserving hydrocarbon vapors that would otherwise escape and add to the contamination of the atmosphere. Thanks in part to compressors, the petroleum industry has just about cleared its skirts of further blame for the smog condition. It is conceded that if pollutants from other sources could be equally well controlled, the smog situation would be well in hand. Before taking a closer look at what the compressors are doing, it would be well to get a general picture of the problem.

Smog is defined as "the eye-irritating, plant-damaging, sometimes odorous condition which forms under certain meteorological conditions." Above us is a sea of air 200 miles deep, but we live in only its lower few feet. Despite aviation, we are essentially 2-dimensional creatures. Atmospheric pollution is closely related to human and industrial activity. Air currents and eddies normally carry off waste products that are released into the sky and replenish our living zone with fresh air. When certain abnormal conditions prevail, this purifying process ceases and these waste materials accumulate rapidly.

About 200 communities in the nation are seriously affected by aerial pollution, and Dr. Lauren B. Hitchcock, former head of the Air Pollution Foundation in Los Angeles said 76 million

of us live where there is noticeable aerial pollution. The national situation is such that Congress, in 1955, appropriated \$25 million for a 5-year study by the Public Health Service, which soon received requests for help from more than 25 areas. Some of the principal trouble spots are Louisville, Ky.; New Orleans, La.; northern New Jersey; Hammond and Gary, Ind.; and the Delaware River Basin, including Philadelphia, Pa., and Camden, N. J.

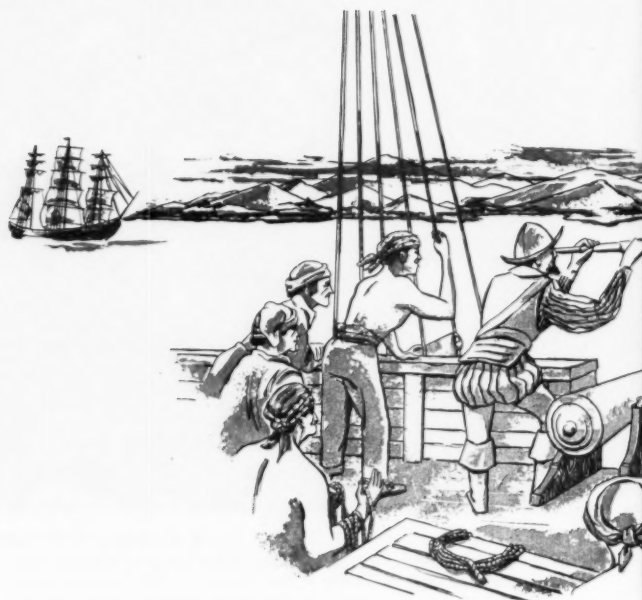
The Stanford Research Institute places the country's direct economic loss from atmospheric pollution at \$1.5 billion annually, mostly in the form of extra costs of cleaning and painting and from damage to merchandise and buildings. The Armour Research Foundation of Illinois Institute of Technology thinks the over-all yearly cost is about \$4 billion. The magazine *Steel* estimates industry's expenditures for air pollution control and prevention during the past 5 years at \$1 billion. Last year the Franklin Institute, of Philadelphia, which, incidentally, studied the hazards of gas lighting when it was a revolutionary development more than a century ago, sponsored a symposium on the subject, "Cleaner Air for Urban Areas." It was the consensus that "polluted air threatens the economic development of our cities, industry-community relations and the health of our citizens."

The problem is worse than it used to be, but it is by no means new. In the year 1257, the ailing Queen Eleanor of England was obliged to leave Nottingham because of the coal smoke. In 1306, although coal was then burned in Lon-

don only by artisans, members of Parliament complained of the smoke, and smiths were ordered to use other fuel while Parliament was in session. In 1648, Londoners, weary of damage from smoke, unsuccessfully petitioned Parliament to prohibit the importation of coal from Newcastle. Around 1800, William Blake, an English poet, wrote of "those dark, satanic mills." Years later a less poetic countryman commented, "where there's muck, there's brass," meaning that dirt and industrial production go hand in hand. Britain now burns about 200 million tons of coal annually and 10 percent of it is believed to be wasted through incomplete combustion. The consequent economic loss is placed at \$650 million. Partly for the sake of a cleaner country, but also because Britain can't tolerate waste of any sort if she is to sell her products in world competition, she recently enacted a Clean Air bill. It promises to help the economy and carry a bonus of better living and working conditions. Pursuing the same line of thought was the prediction in 1945 by the *Scientific American* that "smokestacks will disappear from factories. The gases, heat units and solid materials which they throw off are too valuable to waste."

Sixty persons died during an intense fog in the Meuse Valley, Belgium, in 1930. In November 1950, the accidental escape of hydrogen sulphide caused 22 deaths in Poza Rica, Mexico. More recently, doctors blamed air contaminants for up to 3000 deaths in London. At home, Americans vividly remember the toll of twenty lives taken by atmospheric pollution in Donora, Pa., in October 1948.

Like any living being, a community





"BAHIA DE LOS FUMOS"

More than 400 years ago the Spanish explorer Juan Rodriguez Cabrillo sailed into what is now Los Angeles Harbor and recorded the discovery of a fertile valley protected by mountains. He wrote in the ship's log that the valley was smoky from the fires of Indians and gave it the name that translates into "Bay of Smokes."

some and on 30 to 40 days it is moderate to heavy.

Besides irritating eyes and sometimes respiratory tracts, smog occasionally produces nausea and mental depression and interferes with visibility. Absenteeism and lowered worker efficiency are among its penalties.

Smog is not normally permanently injurious to people in good health, the medical experts say, but they consider it dangerous for those who have pulmonary or heart diseases. They also say that urban residence increases the chances of contracting lung cancer, and smog is a contributing factor in that increased possibility.

Crop damage is an estimated \$3,000,000 a year and is especially severe in the cases of spinach, endive, romaine and mustard, all of which are affected before the smog is strong enough to be felt by the human eye. A typical symptom is the appearance of an oily film with metallic luster on the undersides of leaves. It is called "silverleaf."

Smog apparently upsets Los Angeles residents more than it does visitors, maybe because the natives endure more of it. At any rate, less than 2 percent of the thousands of tourists find the atmospheric conditions disagreeable. Only 1 percent of those interviewed during a survey thought smog was a reason to stay away from the area.

Curiously enough, the temperature inversion gives Los Angeles the semitropical climate that has lured many of its millions. The overlying blanket of warm air holds the ground-level temperature within a narrow range. This was fine as long as agriculture was the principal industry and the population was small. When the section became more crowded and industries sprang up, the roof that held the balmy air below also began to imprison the aerial wastes. Prior to the phenomenal growth that started with World War II, the trap could hold the pollution without creating smog. That is no longer true. From 1940 to 1955, the population of Los Angeles County increased 80 percent; automobiles, 130 percent; and industrial units, 173 percent. Emission of pollutants is 3400 tons a day. Without control, it would be at least 5400 tons.

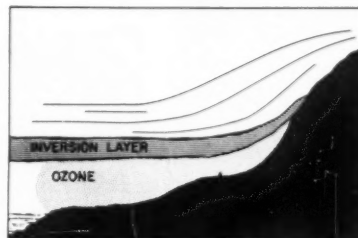
The county is now the most populous in the nation, with 5,600,000 people. The Los Angeles Basin comprises approximately one-third of the areas of

Los Angeles and Orange counties, 1200 square miles. Within it is a great agricultural industry, the center of motion picture production, vast oil refineries, steel, rubber and aircraft plants, a large seafood industry and enough other industries to reach a total of about 15,000 plants and hundreds of thousands of employees. There are 2,800,000 motor vehicles, the highest concentration of cars in America.

More than 50 different pollutants are discharged into the atmosphere. They are a combination of gases and aerosols. (Aerosols are particles of matter, solid or liquid, so small that they can remain suspended in the air almost indefinitely. They include smoke, dust, mist and fumes. Most aerosols come from open fires.) The gases are of many kinds, but hydrocarbons and oxides of nitrogen are the worst offenders.

Add sunlight to this aerial sea of sewage and you have all the elements necessary to create smog. This was definitely proved in 1950 by Dr. A. J. Haagen-Smit of the California Institute of Technology faculty at Pasadena. By irradiating hydrocarbons and oxides of nitrogen with sunlight, he produced something that looked, smelled and acted like smog. It irritated eyes, damaged vegetation and cracked rubber—all standard manifestations of Los Angeles smog.

The chemical reactions that produce smog are complex and not completely understood. It is known, however, that one of the most potent products is ozone. Ozone was recognized as a pollutant by the ancient Greeks, who gave it their word for "stench." It is a dark blue form of the common atmospheric gas, oxygen, but has three atoms to the molecule instead of the usual two. Its characteristic pungent odor may be smelled after a bolt of lightning during mountain



TEMPERATURE INVERSION

A topsy-turvy meteorological condition is responsible for the smog in the Los Angeles Basin. On many days, a low-hanging layer of air that is warmer than that at ground level acts as a lid and prevents pollutants from escaping unless the wind velocity rises above its average of 5.1 mph. The rays from the sun trigger chemical reactions among the pollutants, creating new compounds that irritate the eyes, damage crops and obscure vision. Mountains on the north and east help create the atmospheric trap.

breathes. Its automobiles, railroads, home heating plants, rubbish burners, factories and power plants all inhale air and exhale it in polluted form. Accumulations are noticed on still days, but they rarely become acute. In some places, however, of which the Los Angeles Basin is an outstanding example, conditions frequently prevent such dispersion. In Los Angeles, in essence, there is an atmospheric trap that holds the pollutants near surface level for hours or days at a time.

This trap is a temperature inversion—a condition in which the air gets warmer with height instead of cooler, as is usual. Near the Hawaiian Islands is what meteorologists call the Pacific Pressure Area. Because of the earth's rotation, this air mass rotates clockwise and air descends on its eastern side, along the California shore, being compressed and warmed as it loses altitude. This warm, compressed air meets the air that overlays and is cooled by the Pacific Ocean. The result is a layer of warm air, up to 2000 feet thick, over a layer of cool air. During the daytime, the land is warmer than the water and air moves onshore. At night, the land cools faster than the water and the air flows offshore.

Temperature inversion exists about 340 days a year. Usually it is at a considerable height, or the earth's surface heats rapidly in the morning and the inversion is soon dissipated. Smog begins to be noticeable when the inversion level drops to 1500 feet or less and the wind velocity is below 3 mph. (Wind speeds in the basin average only 5.1 mph, as compared with 8.0 for Chicago and 11.0 for New York.) On about 120 days some eye irritation is felt. On 75 of those days, it is moderately bother-



PHOTO, A. DEVANEY, INC.

NEW JERSEY SMOG

Atmospheric pollution costs the nation somewhere between \$1.4 and \$4 billion annually, depending on whose estimate one takes, and the bill is rising. Some 200 communities, with an aggregate population of 76 million, are affected. One of the major trouble spots is northern New Jersey. This picture was taken near Little Ferry, on Route 46, on a foggy night.

thunderstorms or around certain electric apparatus. It is poisonous to animals and presumably also to humans in high concentrations.

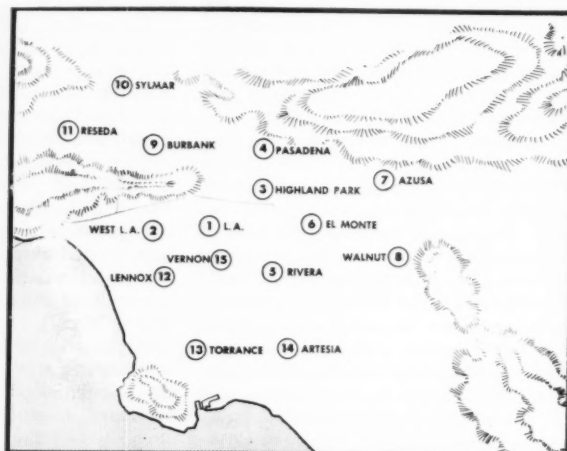
According to determinations made on the site by the Franklin Institute, with

an infrared absorption cell, this is about what happens aloft. Nitrogen dioxide decomposes in sunlight to form nitrous oxide and atomic oxygen. The latter combines with normal oxygen in the atmosphere to form ozone. The nitric

oxide reacts with organic pollutants to form peroxyacyl nitrite (Compound X). If this were not removed it would react with the ozone and prevent the ozone from building up to the high concentration found in smog. To complete the cycle, however, Compound X is decomposed slowly by sunlight to produce nitrogen dioxide, the substance that started the cycle. Thus, the nitrogen dioxide is used over and over in a chain reaction that produces ozone, which means that the amount of ozone can be much larger than the amount of nitrogen dioxide that was there to start.

As he neared what is now Los Angeles Basin by boat on October 8, 1542, the Spanish explorer, Juan Rodriguez Cabrillo wrote in his log, "I am now entering the Bay of Smokes." The temperature inversion was there even then, and in the haze he saw smoke caused by fires built by the Indians. Actually, the experts say, the air over Los Angeles County never was as clear as some old-timers would have you believe. Claims such as "I used to be able to see Catalina Island, 50 miles from Pasadena, every day" stretch the truth badly, they declare. Dr. Haagen-Smit dug into the statistics on the matter and reports that during the presmog era, 1932-38, the island was visible at noon on only 50 days in the year. The figure dropped to 30 days for the period 1938-43 and to 11 days for the 1944-49 span. Since then, there has been a slight, but insignificant, improvement to 15 days.

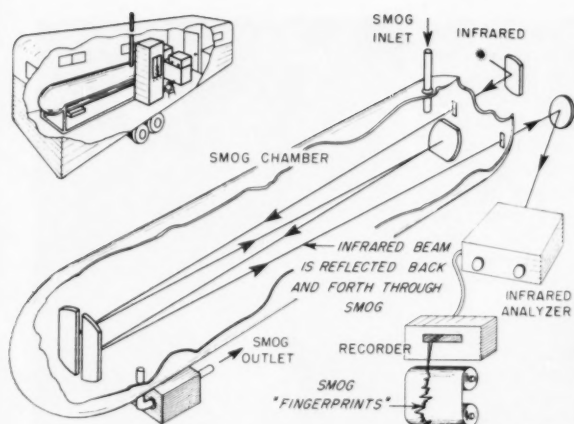
Thus, there was always fog, a manifestation of natural processes—annoying at times, but no worse. The conversion from fog to smog came during the war years. On September 8, 1943, there was a "daylight dimout." A news-



AIR SAMPLING STATIONS

To protect the public health, monitoring stations at fifteen locations continuously check the degree of atmospheric contamination and report by radio, television and press. "Alerts" are given certain key industries when conditions warrant it. Administration of this "Emergency Action Program" requires 55 persons, including chemists, instru-

ment technicians, maintenance and repair personnel. Specimens of smog-sensitive vegetation (left) are kept near the stations and observed daily for symptoms of the crop-damaging effects of smog. Two types of plants utilized are poa annua, a bluegrass that indicates the intensity of smog; and petunias, which indicates the type of pollutant.



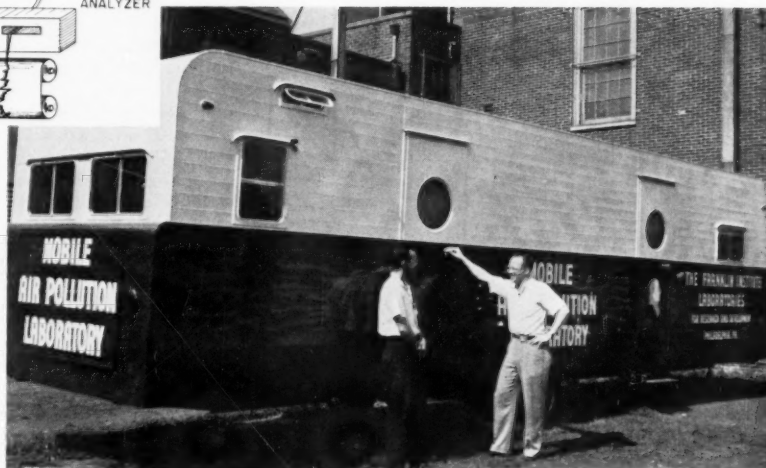
paper reported, "Thousands of eyes smarted. Many persons wept and coughed. Throughout the downtown area and into the foothills the fumes spread their irritation." The cause was traced to hydrocarbons being released from a synthetic rubber factory. They were brought under control and there was some relief, but during the next 18 months there were other smog attacks. The irritation was more persistent and accompanied by a dense, grayish-brown haze, a chlorine-like odor and damage to growing plants.

Public clamor for speedy relief led to the enactment of a state law that permitted counties to form air pollution control districts. Los Angeles County did this in October 1947, and in the following April launched a drive to get at the roots of the problem and combat them. As sulphur dioxide was known to be a source of nuisance in other communities, the first steps were taken against it. Next to receive attention were dust and fumes from foundries and steel mills, open burning dumps and similar rather obvious sources of contamination.

On October 1, 1957, a county-wide ban was clamped on 1,500,000 single-chamber backyard incinerators that had been burning daily up to 14,000 tons of rubbish. The rubbish is now being collected by trucks and burned in equipment that produces no contaminants. Residents may still use approved double-chamber incinerators that assure complete combustion.

The outlawing of the incinerator followed 13 years of discussion and debate on how much it contributed to the smog situation. The technologists warned that its elimination would not solve the problem and estimated that home incinerators were responsible for no more than one-third of the atmospheric pollution. So far it seems that they were right. The situation has noticeably improved, but is still pressing.

An ironical angle of the ban is that the rubbish collection it involves puts



SILENT SAM THE SMOG SLEUTH

Mobile laboratory developed by the Franklin Institute in Philadelphia and sent to Los Angeles to determine which chemicals are responsible for eye irritation and other smog effects. The American Petroleum Institute allotted funds for building the ultra-long-path infrared cell and spectrometer that is the heart of the inanimate detective. A blower draws a sample of the atmosphere through a pipe in the trailer's roof into the steel absorption cell (left). Fluorescent lights inside are turned on to simulate sunlight, which promotes smog formation. A beam of infrared rays enters the cell and is reflected back and forth through the smog by mirrors. After traveling as far as 500 meters, the beam leaves the cell and enters the spectrometer, which analyzes it to determine what portions of the radiations have been absorbed by the smog and to what extent. The recorder then writes the absorption spectrum—smog "fingerprints"—on paper for later study. By comparing this spectrum with a library of known spectra, the impurities in the smog can be accurately tagged. The instrument is so sensitive that it can spot an impurity even if it represents only 5 or 6 parts per million in the sample of air taken into it. "Silent Sam" succeeded in finding "Compound X," which is considered to be the chief offender in smog. Its chemical name is peroxyacetyl nitrite.

additional trucks in operation and adds that many more engines, exhausting the fumes that are recognized as one of the leading causes of the trouble. The experts say about one-half of the pollution comes from this source now.

Research was begun early to determine other pollutants and, one by one, they were identified and blacklisted for subsequent attention. Since then, the Los Angeles County Air Pollution Control District (APCD) has grown to an organization of more than 300 personnel, with an annual budget of \$3,600,000. Substantial reductions in both categories are now planned.

In addition, more than \$12 million has been spent on research projects fostered by other agencies, including the American Petroleum Institute and the automobile industry. The Air Pollution

Foundation, a nonprofit, nonpolitical organization operated by 35 unpaid trustees, was formed to conduct scientific research and to cooperate with other agencies and the public. Contributions, which usually run to about \$750,000 a year, finance its work. It has sponsored research work by Stanford Research Institute, Menlo Park, Calif.; Armour Research Foundation, Chicago, Ill.; Midwest Research Institute, Kansas City, Mo.; Battelle Memorial Institute, Columbus, Ohio; and Southwest Research Institute, San Antonio, Tex.

As the petroleum industry was known to be an important source of hydrocarbon emissions, major attention was soon directed to it. The industry cooperated; it has, actually, been controlling a large proportion of its losses for some years because it was profitable to



INSPECTION AND ENFORCEMENT

Sources of pollution are regularly policed. These include 15,000 industrial establishments containing 100,000 pieces of equipment subject to the air pollution laws and all vehicles on the highways. Polaroid cameras mounted in patrol cars record smoking stacks and truck exhausts and provide evidence for prosecution of offenders.

do so. For additional corrective measures it has spent, since 1948, about \$30 million, half or more of all industry control expenditures.

Pollutant production by other industries is also gradually being brought under control with two exceptions: electric power generating stations and establishments that produce, handle or process solvents. Considerable progress is also being reported in the case of these. Because of insufficient natural gas, Southern California Edison Company's steam plants have been burning fuel oil, from which there have been emissions of sulphur dioxide and other contaminants. In 1956, the company inaugurated a \$1,750,000 smog research program, as a result of which it is now installing a \$1,000,000 precipitator that is expected to be removing the offending materials within a year.

The manufacture of solvents and their use in paints, varnishes, cleaning agents, etc., liberate daily an estimated 500 tons of contaminants. The exact extent of their contribution to smog is yet to be determined. Meanwhile, new installations have been held up. The field is being surveyed and many controls are being installed voluntarily by the concerns involved. A continuation of this course could remove solvents from the air pollution picture.

The control of industrial pollution sources is effected by a permit system that requires APCD approval of equipment or control devices before they may be installed or operated. The industrial establishments contain some 100,-

000 pieces of equipment that are subject to the air pollution laws. Enforcement of the permit system involves more than 70,000 plant inspections each year. More than 70 engineers and technicians of the APCD staff act annually on an average of 8500 applications for permits.

The control regulations have teeth in them. Uniformed inspectors driving patrol cars equipped with 2-way radios and polaroid cameras for gathering evidence, maintain a 24-hour watch for air pollution violators. Fines up to \$500 have been levied for repeated offenses and two men with eleven convictions for open fire burning were given jail terms of 30 and 60 days.

Power plants and solvents can be controlled in due time with no great difficulty. Taking care of motor vehicle exhausts is, however, a knottier problem. When an automobile engine draws in air to burn with gasoline, it exposes oxygen and nitrogen to heat in the combustion chamber. Oxides of nitrogen are formed there and blown out the tailpipe mixed with hydrocarbons. Exhaustive tests prove that cars emit the most hydrocarbons when decelerating. A comparison in parts per million of exhaust shows 354 when cruising, 410 when accelerating, 1275 when idling and 5125 when decelerating.

Basic information on what is needed is still being collected, and no one is certain just when it will be complete. After the solution is obtained, there will still be the task of devising a cure and putting it into effect. The search for the answer is following two avenues of approach—one physical and the other chemical. The first encompasses the examination of such devices as fuel shut-offs and afterburners, along with improvements in the method of fuel injection, in combustion chamber design and in the gasoline engine itself. The chemical aspect includes such possibilities as changes in fuel composition and chemical treatment of the exhaust gas.

It is conceded that the discovery of a suitable device or method for controlling the exhaust will not end the problem. The remedy must be made available at a reasonable price, the legal authorization for its application must be established, and it must be applied to nearly 3,000,000 million vehicles. A program of inspection and enforcement will have to be instituted. It is estimated that after the sought-for control measure is found, at least 3 years will be required to get it into operation.

The cost of the first 10 years of the smog combat is computed at nearly \$73 million. Of this sum, industry has spent \$50 million; the APCD, more than \$10 million; and research by other agencies has aggregated \$12.5 million. Heavier expenditures loom. Some estimates place the bill during the next 5 years at more than \$250 million, divided as follows:



CONDEMNED INCINERATOR

The backyard trash burner, described as hardly more than four walls with a fire-screen on top, was banned in Los Angeles County last October following 13 years of argument over how much it contributed to the smog condition. One and one-half million of the burners had been disposing of 14,000 tons of rubbish daily. It is now collected and burned in equipment that produces no aerial contaminants. Residents are permitted to use double-chamber incinerators that assure complete combustion.

\$30 million for industrial control devices, \$150 million for auto exhaust control devices, \$45 million or more for collecting and disposing of refuse, \$15 million for the APCD program and \$15 million for research by other agencies.

Los Angeles has spent \$750 million on water supply, \$300 million on its sewer system and several billions on highways. Some authorities think it will have to spend on the same scale to rid itself of smog.

The problem is, of course, complicated by the continuing influx of people and industry. The newcomers increase the emission of pollutants to about the same degree that control measures reduce them. About 1000 industrial plants are added annually. Estimates place the 1970 population at 8,000,000 and industries at 27,000, compared with 5,000,000 and 15,000 now. If they are accurate, the situation will grow progressively worse unless better controls are applied.



(Part 2 will describe control measures practiced by the petroleum industry.)



The Bridge At Bayou Boeuf

EVEN with its melodious and serene-sounding name, the quiet stream of Bayou Boeuf in Louisiana was the focal point for more than its share of transportation frustrations until just recently. It is at this location, about 85 miles southwest of New Orleans in the large fan that makes up the Mississippi River Delta, that Louisiana's busy Highway 90 crosses the Gulf intracoastal waterway. The Bayou, near Morgan City, La., links Lake Palourda with another stream, Bayou Black, to form a north-south section of the inland water route. An old drawbridge, that carried the highway across the water, often had to interrupt vehicles to allow waterway traffic to ease by, and just as often held up vessels when auto crossings were numerous. To break this double bottleneck, it was decided that a long bridge must be built to vault the waterway, providing ample clearance for the craft below and unrestricted passage for vehicles above.

The need for the bridge came as direct evidence of the commercial expansion that has been occurring in the South-

lands in general. In Louisiana, this southern coastal area has felt the revival in particular. Oil fields are worked both on land and in the Gulf, blending with the vigorous oil industry of Texas just to the west; fishing fleets have been on the increase; and shipping is more active than ever before. As a result, commercial traffic has grown and forced a strain on the main transportation arteries.

In this section of the United States, such long bridges as the Bayou Boeuf structure are not rare, for the slow-draining streams of the area often spread out to great widths during rainy periods. Indeed, in many parts of the state the roads themselves often appear, for long stretches, to be bridges above the swamplands surrounding them. Observation reveals, in such cases, that the highway one is traveling is actually a "solid" bridge, that is, a road built atop a high earth fill, giving one a sensation not unlike the crossing of a dam road.

Consistent with this practice, the bridge erected at Bayou Boeuf is 3655 feet long and contains 63 spans, even

POSITIONING CENTER SPAN

Above, one of the 100-foot-long sections of Bayou Boeuf bridge is swung into place; five of these make up the middle span, and all were joined with high-strength bolts using Ingersoll-Rand's Torsion Bar Torque Control Impacttools. At this point, the bridge crosses the vital waterway with a vertical clearance of 73 feet at high water.

though horizontal clearance for the channel is only 125 feet. Vertical clearance over the waterway is 73 feet at high water and 76 feet at low water. The elevating grade of the bridge is 5 percent.

From a distance, the structure appears as a long, swooping arc over the important water route. Steel piles, driven from 50 to 100 feet into the ground, support the foundation pedestals, and two basic column designs are used. Spans 1 through 9, and 49 through 63, the extremities of the structure, are carried on cast reinforced concrete columns. The mid-section, composed of spans 10 through 48, is supported by a cross bracing of bolted steel columns.

Bayou's Meaning Is Confusing, At Best

Though pleasing to hear, the word "bayou" is not nearly so pleasant when trying to communicate its meaning accurately.

The word has French and American Indian backgrounds, an example being the Choctaw word *bayuk*, meaning a small river, or a branch, in a delta. Webster states that the noun still has the same general meaning as this Indian usage, but that it is used many other special ways. For instance, in Louisiana, at the location of the bridge discussed in the accompanying article, the word means a creek or a secondary watercourse. In a few counties of northern Arkansas and southern Missouri, it refers to "a clear brook or rivulet arising in the hills." Bayou can also mean an intermittent, partly closed or disused waterway, especially one that is sluggish or stagnant. Further, it can be defined geologically, as Webster does, by saying that a bayou is the "typical watercourse of the Pleistocene or Quaternary area of the Mississippi Embayment, where the term *bayou* is the term in almost exclusive use." In short, it appears that the word could be used in almost any way referring to any not-too-large body of fresh water.

The expression "Bayou Boeuf" is not precise either. While double checking the location of the Bayou Boeuf for this article, we found some three such streams in Louisiana, all within a fairly small radius, though there appeared to be no apparent physical relationship. It was noted, too, that near the location of the bridge described, there is a small town named Boeuf. This word is French, of course, and means beef. If we translate the name of the stream concerned, and call it Beef Bayou, the term loses its sonorous quality and calls up quite another image.

The main girders over the water form a continuous 500-foot span that was bolted together, at the site, from five 100-foot sections. These long girders were fabricated from 7-foot-high plates, with top and bottom plates welded on to form I-beams. All the cross members and girders were delivered in sections, because of limitations of highway transportation, and assembled on the site. The 2-lane roadway, that forms the uppermost part of the structure and actually carries the traffic, is of reinforced concrete, 7 inches thick.

A unique feature of the bridge is that it was bolted together with high-strength bolts instead of being assembled by riveting. The contractors, W. R.

BAYOU BOEUF BRIDGE

Oblique view of Bayou Boeuf bridge showing several spans, including the 500-foot center section at the left portion of the photograph. The bridge is 3655 feet long and has a total of 63 spans. Fairchild-Snowden's own field concrete plant is visible through the bridge structure, at the right of the picture.



IMPACTOOL RUNS BOLTS

All steel in the Bayou Boeuf bridge was assembled with $\frac{7}{8}$ -inch high-tensile-strength bolts run with Ingersoll-Rand Impactools, as shown in this photograph. The fasteners were tightened to torques of 470 to 500 foot-pounds. The 2-man bolting crew averaged 800 bolts a day. A total of 36,025 went into the structure.

Fairchild Construction Company, Limited, and J. W. Snowden Construction Company of Hattiesburg, Miss., that had just completed erecting a bolted bridge with conventional impact wrenches, decided this time to use Ingersoll-Rand's 5340T Torsion Bar Torque Control Impactool for tightening the nuts. This pneumatic impact wrench allows the operator to set the tool at any desired torque to tighten the nut—even as great as 550 foot-pounds. When the tool exerts the preset torque on the nut, a mechanism in the device rebounds instantly and shuts off the compressed air supply.

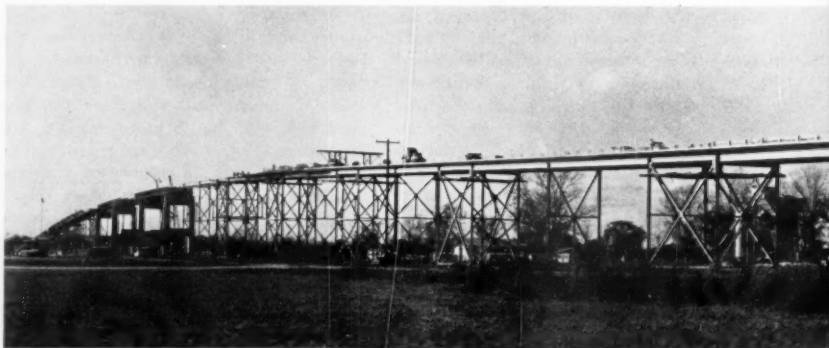
The advantage in this Impactool is the same as with any job where man must compete with machine: the machine can do a much better and more consistent job without fatigue or error in judgment. As a result, the structure being assembled by the tool is safer because the bolted connections are consistently strong. There is an advantage

to the operator too—the responsibility for supplying the correct torque is not left to him, but is assumed by the Impactool. The operator needs only to position the tool.

About 95 percent of the assembly work on the Bayou Boeuf bridge was done in the air, with the Impactool crews working from platforms and scaffolding. This was necessary because the bridge components were huge subassemblies—such as the 100-foot-long girders of the main span. These were lifted into place by cranes and, of course, were impossible to join by working from the ground. Aerial work was even necessary at times during the fitting together of the subassemblies before their movement to the bridge site. Despite the working problems more commonly associated with steeplejack missions, a crew of two men using the Torque Control Impactool was able to run an average of 800 bolts per day. Normally this speed was sufficient to keep pace with the number of bridge members that needed to be bolted. A second Impactool, kept on hand as a spare, was used only occasionally. The 2-man crew which attained the 800-bolt average while working aloft, where scaffolding had to be constantly repositioned, actually was able to run 300 accurately torqued fasteners per hour under favorable conditions on the ground.

A total of 36,025 high tensile strength bolts of $\frac{7}{8}$ -inch diameter went into the bridge. These were $2\frac{1}{2}$ - and 3-inches long and were fitted with hexagonal nuts and hardened washers. Fairchild-Snowden set the Impactools so that the fasteners would be driven at torques between 470 and 500 foot-pounds. Bolt tensions thus developed were in excess of 37,000 pounds, the figure recommended by the Research Council on Riveted & Bolted Structural Joints.

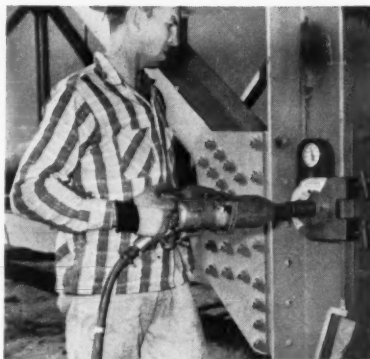
The tools were set to the desired torque on a simple jig and then tested by running three or four of the fasteners on a Skidmore-Wilhelm hydraulic calibrator. This instrument gives a direct reading in bolt tension. It was necessary to re-adjust the setting only about once in a 5-day period. As a double check,



inspectors from the Louisiana State Department of Highways tested 15 percent of the nuts with hand torque wrenches and found the torque to be uniform and consistently above the specified minimums.

In the construction of the bridge that Fairchild-Snowden had built just previous to the Bayou Boeuf job, the conventional impact wrenches were tested by their operators every morning. The men would run a few test nuts and time the period required to reach the required torque. Although this method of assembly was much quicker than riveting, it still left torque to the operator's skill, judgment and general ability. If an operator's "eye," or more correctly, his "ear"—for many operators judge torque by the sound of the impacts—happened to be off one day, probably both his connections and the resultant strength of the bridge suffered. At best, this method required extensive time and labor for checking with hand wrenches.

Nonetheless, whichever impact wrench type is needed, bolting has several advantages over the riveting method of joining large structural members, such as went into the Bayou Boeuf bridge. Perhaps the chief advantage is man



TESTING BOLT TENSION

Impacttools used at Bayou Boeuf were tested on this Skidmore-Wilhelm hydraulic calibrator which gives direct readings in bolt tensions. State inspectors checked 15 percent of the fasteners used in the bridge and found torques to be uniform and consistently above prescribed minimums.

power. In riveting, a specially trained crew of five workers is needed: a riveter, a backer-up, an individual who inserts the hot rivet, a rivet heater, and a "punk" who keeps supplies available for the other crew members. If one of them

is unavailable, the others can't work until a suitably trained replacement is found. Considerable skill and experience are needed by this crew for such things as selecting the correct rivet size, heating the rivet to the right temperature and driving the rivet itself.

In an impact wrench crew, only two men are required, and they need little experience. Enos Fanguie, project superintendent on the Bayou Boeuf structure, substantiates this by reporting that he found any man who could work on steel was able to operate the automatic Impactool. This meant a saving of three men, not to mention the question of skill and training involved.

Another advantage of bolting over riveting is speed. A good riveting gang, working on such a structure as Bayou Boeuf's bridge, would be able to put in about 400 rivets a day, as compared with the 800 bolts per day that the Fairchild-Snowden crew averaged. At first glance the 400 figure does not appear to measure up too poorly with the 800-bolt figure, until the two are examined on a man-hour basis. The Bayou Boeuf's crew averaged 400 bolts per man-day, while the riveting gang would have averaged only 80 rivets per man-day.

Air Cushion Aids Submarine Drilling

WHILE busily deepening Ontario's Welland Canal to St. Lawrence Seaway specifications, a Canadian contractor has boomeranged one of the basic and most perplexing principles of explosives into a definite aid to submarine demolition. The law is a familiar one; it states that explosive gases will follow, at all times, the path of least resistance. Throughout blasting history, this fact has been kept in mind at all times by demolitions personnel, and frequently has caused great problems, especially when controlled explosions are sought.

The name of the new technique is "air cushion." It is being practiced by McNamara Construction Company, Limited, during the deepening of the 25-mile-long canal to a minimum depth of 27 feet between Port Weller and Port Colborne, Ont. The Welland project was described in the November 1957 issue of COMPRESSED AIR MAGAZINE, though details of the air cushion method were not available then.

Air cushion's use for submarine blasting is simple: it consists of drilling a line of holes at the desired boundaries of an excavation. Into these are placed empty cans, containing air at atmospheric pressure and hermetically sealed. (Any gas may be utilized as well as air.) When the blast is fired, the force is directed toward the line of weakness

formed by the cans. The result is that the rock breaks cleanly at the required excavation plane.

The cans are 3 inches in diameter, 3 feet long and fashioned from standard 28-gauge spouting, the same as that designed to carry off water from eaves troughs of residential buildings. Two of these troughs are placed together, and a 1-inch-thick circular wooden plug is placed in the center of each can for strength. A nail through the metal holds the plug in place. The nail hole, both ends of the can and the sides are soldered to make the device watertight. Three metal wings attached to the bottom ends keep the cans from floating to the surface when placed in the subaqueous holes. These springy strips are bent out and act as barbs, allowing the cans to be inserted but preventing their escape.

In surface blasting, essentially the same technique has been in practice for some time; a series of weaknesses is formed by simply providing a row of line-drilled holes. In submarine work, however, such a row merely fills with water and is useless, water being nearly as incompressible as rock.

The normal pattern resulting from a submarine blast, without air cushion, is a series of cone-shaped craters formed by the movement of individual explo-



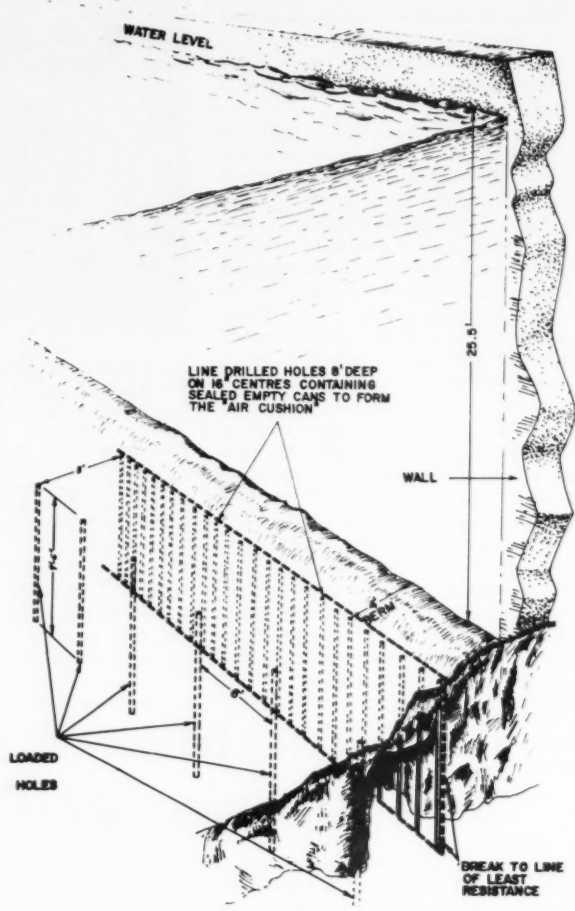
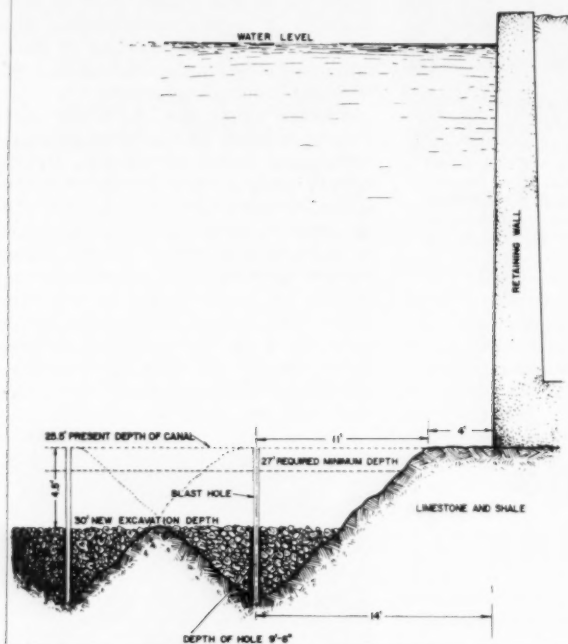
AIR CUSHION INVENTOR

Inventor of the air cushion technique, A. "Lap" LaPrairie of Canadian Industries Limited, examines one of the air-filled cylinders used for the new submarine blasting method. The 3-foot-long can is made from eavespouting, is hermetically sealed, and has metal strips affixed to the bottom that act as barbs for anchoring the device in the underwater hole.

sions toward the water's surface—that is, in the route of least resistance. This pattern was one reason why McNamara sought a new method. The edges of the underwater craters, several feet in height, made necessary much subgrade drilling and the use of large additional charges. This irregular blasting also made it difficult to obtain the needed clean-finished line of excavation.

OLD METHOD VS. AIR CUSHION

The sketch at the left shows the irregular effect produced on the Welland Canal floor without air cushion. Blasts form deep craters as the force of the explosion rushes upward to the water surface. More drilling and shots are necessary to produce a smooth bottom surface for safe passage of vessels. The drawing at the right illustrates how air cushion has been applied. A row of air-filled cans, 4 feet from the wall, forms a weakened plane that receives the blast force for a clean cut. Loaded holes are spaced at 6-foot intervals, 9 feet from the canal side. A safe 4-foot wide berm results.



The contractor especially needed this unmarred line when working near the sides of the canal. With the conventional underwater blasting method, a berm 14 feet wide and about 4 feet in depth resulted, causing an obstacle to docking and passage of the deep-draft, flat-bottomed lake vessels that pass through the canal. Because the old method is difficult to control, Welland Canal authorities required that charges be at least 14 feet from the sides to protect the canal walls.

To insure maximum room for ships in transit, the contractor initially used the air cushion for an especially important section of the watercourse. A row of line-drilled holes, 6 inches in diameter, was put down on 16-inch centers. These were 8 feet deep and were placed parallel to, and 4 feet from, the toe of the canal wall. Two air cushion cans were inserted in each hole to provide the necessary weak, compressible plane. After firing, the method was found to be successful, and only a harmless 4-foot berm remained.

Air cushion's effectiveness so proved itself that subsequently the contractor was allowed to drill his blast holes only

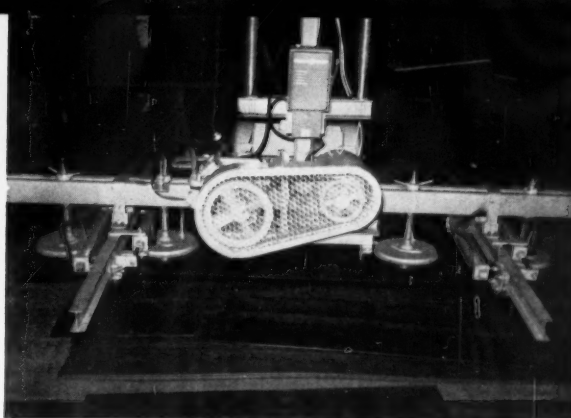
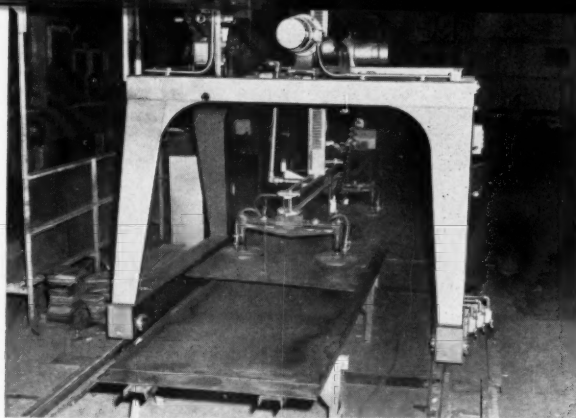
9 feet from the toe of the wall, instead of at the previous 14-foot limit. In current submarine blasting on the canal, due to the success of the new method, the cushion is placed flush along the foundation line of the waterway's retaining wall, the charge holes are brought in closer also, and the berm is eliminated altogether. Seismic tests, conducted for McNamara, found the new method reduces ground vibration, thereby protecting near-by structures from potential blast damage. Recordings indicated that the energy ratio of vibration at the 9-foot blast line, with the cushion in use, equalled the vibration previously obtained with blasts 21 feet from the canal walls, with the older technique.

If the parent idea for the development of air cushion came from the same basic principle as used in surface blasting, then the innovation may have a chance to repay its forebearers. It is possible that the same air tubes may be utilized for shatter cuts in sinking shafts in mines where water is almost always present and has made the forming of weakness lines with rows of plain drilled holes impossible. The shatter cut is often used in hard-rock mines for drifting,

crosscutting and raising. It has several advantages over other types of cuts, including a reduced throw of muck and a consistency of results, both of which make firing a complete round in one shot possible.

Air cushion was developed for the McNamara Construction Company, Limited, by the Explosives Division of C-I-L, Canadian Industries Limited. Specifically, its inventor is A. "Lap" LaPrairie, a member of the Canadian concern.

Another air technique in use on the Welland Canal deepening project is called "air curtain." Although having been used before on a variety of projects, it has an unusual application on the canal. It is being applied to protect drill boats from underwater explosions, thereby making it possible for them to stay in the immediate vicinity of the blasts. Several perforated pipes, running crosswise under a drill boat, have air piped to them. As air is passed into the pipes and emitted through holes, bubbles are created. This air blanket absorbs the shock waves of the blast because the homogeneity of the incompressible water mass has been broken.



TWO APPLICATIONS

The illustration at the (left) shows a Noble Company vacuum plate handler in operation with a floor-rail-mounted gantry. The center column on the unit gives additional support to the four vacuum cups at the corners of the sheet being moved. An Ingersoll-Rand vacuum pump and compressor unit is mounted at the top of the handler (left). The other

photograph illustrates how the Noble system can be adapted to an overhead crane. Note the clamping devices that roll towards the workpiece as it is lifted to provide additional safety and stability; and the "stiff leg" columns to prevent load swinging. Behind the wire screen protector is the Ingersoll-Rand 2-stage vacuum pump.

VACUUM-LIFT PLATE HANDLER

MATERIALS HANDLING for most production and fabrication processes has been mechanized and automated to high efficiency during the last few years. A notable exception has been the handling of heavy sheet and plate. This is traditionally done with overhead cranes, slings and grabs—all supplemented with considerable muscle power. Workers pry up the plate to attach a sling hook and a crane operator hoists and transports it to a machine feed table, workers guiding its movement from the floor. The slings are then removed, and the plate is manually positioned.

To eliminate this slow, costly and potentially dangerous manual operation, Noble Company of Oakland, Calif., developed a fully automatic plate-handling system that can pick up a plate from any one of several stock piles, deliver it to a machine feed table and release it in the desired position—all with the touch of a button.

A considerable problem in the initial design phase was that of evolving a means by which the plate could be automatically picked up and released. The solution was found in the use of vacuum cups. These offered the advantages of attachment on contact, ability to handle both ferrous and nonferrous materials and protecting carefully finished or coated surfaces from marring. Heart of the vacuum-lift system is a heavy-duty industrial piston-type vacuum pump. Noble systems utilize Ingersoll-Rand Model V244X2 or Model V235X1 units, depending upon attachment and lifting loads required. (Standard Noble units have a lift capacity ranging from 1 to 4000 pounds; greater ratings are available for special applications.)

Reliability becomes increasingly more important as the degree of mechanization increases. In an "automated" hand-

ling system, failure of a single component can bottleneck an entire department or plant, resulting in very costly down time. Noble engineers knew this well when they specified the I-R V-type combined vacuum pump and compressors; they feature overhung crankshafts enabling the use of solid-end connecting rods, thus reducing pump maintenance down time.

Having solved the problem of automatic attachment, the company designed a gantry-mounted lifting frame to support the vacuum cups, motorized the lifting and travel operations, and added a completely interlocked automatic-sequencing control system.

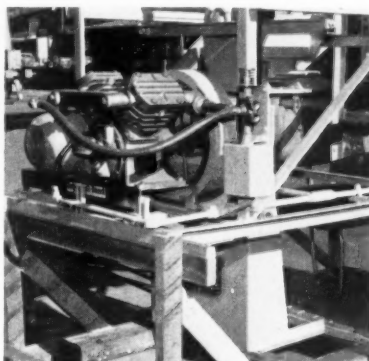
Lift frames are designed so that the arrangement and spacing of the vacuum cups can be easily varied to accommodate various plate and sheet sizes. The cups, usually four in number, can be ar-

ranged "in line" to handle long, narrow workpieces, or in pairs to handle wider sheets. A pressure switch, interlocked in the lift motor circuit, prevents lifting the load until proper vacuum is attained. Where desired, lift frames can be rotated to pick up and handle plates for either end or edge shearing.

The travel gantries, that support the hoist and travel mechanisms, lift frame and the Ingersoll-Rand compressor, may be one of three types: rail-mounted, traveling on rails installed in the floor; overhead rail-mounted; and radial, in which one end of the gantry pivots about a center post with the outer end traveling on a circular track. The first two are used to feed shears, press brakes, cleaning, descaling and similar processing machines. They operate from one or more stock piles arranged along the rail layout. These same units are also utilized to repile plate from cleaning machines and transfer it from conveyors to piles and machines. Radial gantries are generally used to transfer plate from cleaning to processing machines, and back and forth between conveyors, stock piles and machines.

To meet the need for semiautomatic handling equipment where tonnages do not warrant complete systems, Noble Company developed a "pushbutton" handler that mounts on the customers' overhead cranes. This features the same vacuum-lift system and attaches to the crane with a "stiff-leg" column that eliminates load swinging and swaying. Hence, one man can easily move stock from piles to machines. Interlocked mechanical safety grabs prevent load dropping in the event of power failure.

Thus, with the help of air power, plate and sheet handling has been "automated" to match the needs of today's high-speed fabricating processes.



HEART OF THE SYSTEM

This Ingersoll-Rand V235X1 2-stage combination vacuum pump and compressor furnishes vacuum at 29.65 inches of mercury to a Noble Company plate handler. It was selected because it requires little maintenance; and thus, lessens the chance of costly down time.

Custom Cabinet Manufacturer Uses Compressed Air To Gain—

IMPROVED QUALITY AND INCREASED QUANTITY

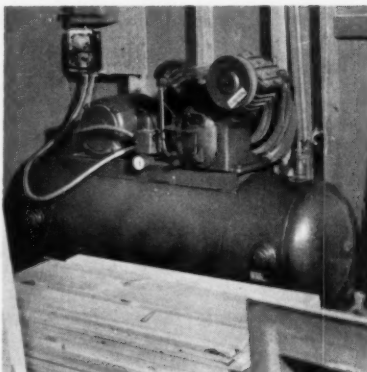
SPRAYING glue instead of applying it with a scratcher, paint brush or roller has saved time and space, while at the same time, it has improved quality at House of Cabinets, Inc., Warren, Mich. Compressed air is the key to the system.

Before the new method was used, glue was applied by hand to both wood and plastic in the more familiar manner. Parts were then put together, clamped in a press and stored for about 12 hours for drying. The method resulted in a high rate of scrap since there was no means of checking the clamping to determine if material was cocked. Glue coverage could be uneven, resulting in unglued patches that, during processing or service, failed.

In making tops of laminae for kitchen cabinets, vanities, bar tops and such custom work, all the material was fed into the fabrication building and proceeded along a gravity roller-conveyor through the length of the building. Completed pieces were delivered from the opposite end of the factory. The lamination processes caused a serious bottleneck in the operations.

After a considerable period of research, it was determined that a pneumatic spray method of applying the glue would be better. Experiments with various glue consistencies, coverage rates and rolling pressures were initiated, and an Ingersoll-Rand Type-30 compressor was installed. A separate production line was arranged for the laminated-plastic cabinet exteriors. As they were fabricated, they were delivered from their own line to the main system for final assembly.

Two vital steps that reduce cabinet-



KEY TO THE SYSTEM

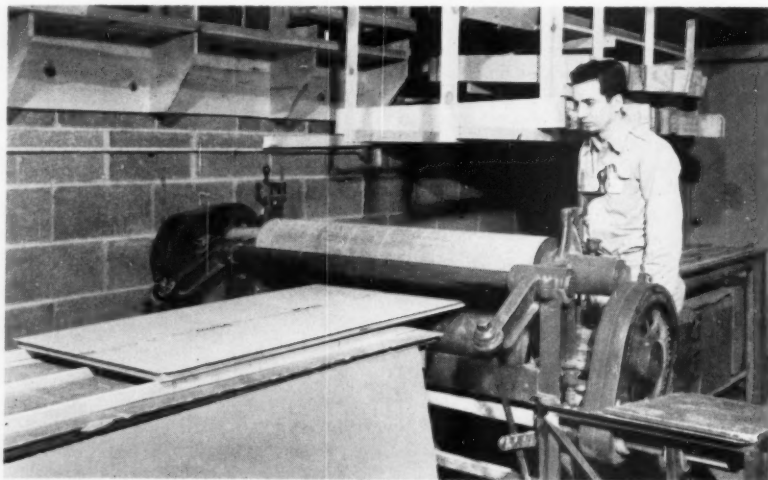
This Ingersoll-Rand Type-30 compressor supplies air at 180-psig pressure for spraying glue. A 7½-hp, air-cooled, 2-stage unit is also used to power air staplers on the production line.

available for processing and integration into the production line.

Air is supplied to the system at 180-psig pressure by the air-cooled, 7½-hp I-R compressor. This powers a liquid spray pump. An operator uses a hand spray gun to coat one side of the plywood base and the underside of the laminated plastic covering with a smooth, thin layer of glue. The wood base and the plastic top are immediately put together and run through compression rolls to develop a permanent and uniform adhesion.

As soon as the workpiece has been run through the rolls, trimming, drilling, cutting and edging operations follow without waiting for drying. Hence, there is no need for storage space to stack the tops, and there is less scrap.

top processing time in half, while reducing the amount of scrap are the application of a smooth, even coat of special consistency glue to both the wood base and the plastic overlay, and adhering the parts by running them through compression rolls. Since storage is eliminated with this process, seven or eight tops never have to be unstacked to get the pattern needed. The right top is always



BASIC OPERATIONS

In a separate production line, a smooth, evenly spread layer of special consistency glue is sprayed (left) on the adjoining surfaces of a wooden base and a plastic top section. These are immediately placed together and passed through compression rollers (above). The rolls apply pressure uniformly across the complete surface and the top is immediately ready for drilling, cutting and trimming. Because of the system, there is no storage problem and the quantity of pieces that has to be scrapped is reduced.



Pioneer Days Of Marble Quarrying In Tennessee

Paul Ziemke



PHOTO, PAUL A. MOORE

KNOX COUNTY QUARRY OPERATION

DATES on moss-covered tombstones in Tennessee indicate that marble was brought into use there during the eighteenth century. The variety of the stone is a clue that it came from some well-known deposits near the Holston River. This was, perhaps, the beginning of what is today a profitable Tennessee industry.

Stone was cut not only for tombstones, but for a limited amount of such marble work on buildings as steps, trim, porch floors and flagstone walks. Nevertheless, marble traffic was sporadic for a number of years.

In 1837, an order to furnish stone for the Marble Room in the U. S. Capitol was received. To fill it, material was quarried from Rogersville Marble Company in Hawkins County, the first known commercial stone operation in Tennessee. These pioneer efforts were

greatly assisted by the State geologist, Doctor Troost. Later, Wisconsin built a new capitol, utilizing stone from every state in the United States. Of all that went into the structure, Tennessee marble made up the greatest tonnage.

Still later, each state was asked to submit stone for inclusion in the Washington National Monument. Tennessee sent the now popular and distinctive pink, or strawberry, variety. It so intrigued the committee that it delegated an agent to investigate both the quality and quantity available. Subsequently, a large quarry, known as Dougherty, was opened to better utilize the thick, unseamed beds that were found near the Holston River. Stone was lifted by horse-tread-powered derricks to ox carts and then moved to the river's edge. The quarry's proximity to the water made this a relatively simple transfer. After

moving downstream by barge to Chattanooga, the stone was placed aboard railway cars that were pulled by wood-burning locomotives. Other orders were shipped directly to the tidewater at Charleston, S. C., or Savannah, Ga., before moving northward to Washington. In all, Tennessee claims to have furnished about one half of the stone for the Monument, and at a later date, a considerable quantity that was used in the fine cut-work on the Capitol. Quarrying had become a major operation.

Orders became more frequent, and the resulting increase in traffic interested railroad builders. It wasn't long before the Civil War that the Southern Railway pushed on to Rogersville, thus assuring all-season operation. Formerly, lowering of the river's depth in times of drought often had stopped production.

Mechanization began in the industry in about 1875 when, at the Hawkins County quarry of Hasson Company, the first large, steam-powered channel drilling machine was installed. At the same time, explosives came into use. An 8-ounce charge, or pinch, per hole was fired to spall off the line produced by the channeler. Bigger and more uniformly dimensioned blocks that could be moved with a minimum of machine power were possible, and there was a general quarry expansion.

Compressed air followed steam in about 1905 when steam-powered compressors came onto the market. These were of the double flywheel variety with handspike holes along their perimeters to facilitate cranking the engine off dead center. The first boilers were of a vertical design with fire-tube construction. These teapots, as they were called, were notorious smokers since no exhaust steam was piped to the stack for forced draft.

With the increasing demand for power, both for the compressor them-

selves and for derricks, so as to increase the size of rock that could be handled, locomotive-type boilers became popular. They produced a wet, low-pressure steam. Apparently, early master mechanics were against insulating the boilers, compressor cylinders and transmission piping. Although the largest heat losses were those along the long lines extending to the channelers and the sump pumps deep within the quarry pits, one can imagine the temperature in the boilerhouses during midsummer. There was at least one enterprising operator who utilized sawdust as an insulation. He packed it into the wooden launders that surrounded his pipelines. Although it was not the equivalent of the magnesium and asbestos combinations we know today, it undoubtedly saved him many tons of coal annually. More important, his ingenuity produced hot, dry steam.

With the passing of time, the marble industry blossomed in the Knoxville area, finally outstripping the Hawkins County producers who ceased operations in about 1912. Of the new quarries, the largest was begun in 1852. It was operated by James Sloan and furnished the bulk of the stone that went into the construction of the Tennessee and Ohio capitols. Oldtimers in the region claim that the product from this quarry, and its predecessor operations in Hawkins County, has the most perfect strawberry coloration of the distinctive Tennessee marble.

With the advent of steel skeleton building techniques, architects found an increasing use for marble. Other quarries came into production in the '50's, producing slabs that proved wear resistant when used as flooring in public buildings. Cutting of such slabs made much of the small-sized stock profitable,

whereas formerly it had been used for rip-rap or railway ballast.

Tennessee may well be proud of its marble industry, where today, the economical hydroelectric power furnished by the Tennessee Valley Authority permits the stone to be channeled, wedged and blasted; and hoisted, cut, ground and polished with an ever-increasing tempo. Three of the largest companies in Knoxville are looking forward to a "good year" in 1958. Many government contracts have already been let. Condora Marble Company, for example, states that 30 to 40 carloads are slated for the Robert Taft Memorial that is being built in Washington. Georgia Marble Company is sending 300 truckloads to the contractor building a 29-story state office building in Pennsylvania as well as some 14 carloads to the new U. S. Air Force Academy near Colorado Springs, Colo.

Raising The Roof With Air Power

CONSTRUCTION workers have long realized the direct benefits of compressed air. Now, it is helping them in a more round-about way. Giant rubber bags are being puffed up daily at Glen Canyon Dam and Powerplant site, Page, Ariz. The balloons were designed and manufactured by B. F. Goodrich Aviation Products to lift the roofs and lower the floors of demountable buildings made by Transa Homes Corporation. Approximately 126 living units have been ordered for the Upper Colorado project by the U. S. Bureau of Reclamation.

These houses differ from the conventional mobile homes in that walls, floors and roofs unfold to form a 520-square-foot house with four spacious rooms and bath. Heavy structural members are hinged to form one side of each unit, thus reducing the required trailer size for over-the-road transit. Each hinged roof section weighs more than 2000 pounds, and the floor, including the folded side and end walls, exceeds 4500 pounds.

Each air bag is manufactured of a special fabric-coated rubber that resists extremely high and low temperatures, petroleum products, mildew and abrasion. The bag weighs 80 pounds and folds into a package that is 36 inches square and 15 inches high. Inflated with 1450 cubic feet of air, it measures 11 feet in diameter and has a length of 15 feet.

To set up the building, a bag is positioned under the roof section and inflated. As it swells, the roof is raised—an operation that requires only 3 minutes. An ordinary tank-type vacuum cleaner may be used to fill the bag, the pressure required being less than 1 psig.

Once the roof is up and supported by props, the hinged floor, containing the

side and end walls, rests directly against the air-filled cell. As the balloon is deflated, another 3-minute job, the floor is gently lowered to its foundation, and the walls are swung into position.

Formerly, sixteen men, working 3½ hours, were required to support the outer edge while the floor was being lowered. With the air bag, the entire cycle can be performed by two men, in a fraction of the time formerly needed, without any of the inherent hazards that were once an accepted part of the work. The speed of raising the roof can be controlled by regulating the amount of air that is fed into the bag. This can be done

either at the air supply source, or by pinching a 12-inch-diameter fabric inflation tube.

It is reported that the bag can be used over and over again. When it is not used as a building tool, it could transport water when placed in a dump truck and filled to the limits of the vehicle, or it might be used, in a deflated state, as a tarpaulin to cover equipment. (Deflated the cell covers approximately 300 square feet.) Transa Homes reports that the device has many other similar applications—all of which would be time and money saving to construction companies.



AIR CONSTRUCTION

The large air bag illustrated here raised the roof in just 3 minutes. More than 100 demountable homes manufactured by Transa Homes Corporation are receiving the same treatment at Glen Canyon Dam and Powerplant site where they are providing housing facilities for construction workers. Fully inflated, the cell measures 11 feet in diameter and 15 feet in length. When it is not being used thusly, it has many other applications.

This and That

2000-Year-Old Forge

While working on the excavation of an ancient city that, when it was flourishing, covered the 3300-foot-high Magdalens Mountain in Carinthia, Austria, archaeologists have uncovered a pre-Roman iron forge. The name of the city has not yet been established, although it is thought that it was once the ancient city of Noricum. There is no place on the vast mountain sides in this northern portion of the Klagenfurt Basin, which lies on the Yugoslavia-Austria border, that there has not been found remains of the Celtic city. Careful excavation has disclosed magnificent buildings of huge proportions built of stone blocks. By the size of the city, it has been assumed that it was not only the cultural and political center of a pre-Roman Noric state, but its capital. By uncovering the forge, previously gained fragments of information are beginning to fit together. Explanations of the vast quantity of iron goods found and of a smelting works that was located under a more recently built Roman temple, are becoming clearer. (The first Roman penetration of this basin was estimated to have taken place in about 16 B.C.) There are a number of furnaces in the smelting works, each built of clay and fitted with bellows that directed strong jets of air into the fires. Next to each furnace was a water basin into which the metal was thrown after smelting to cool. The archaeologists have even found heaps of slag all about. It was here that the ingots for the forge shops were evidently poured. Around the forges were found many clay pots, probably used as food containers. Scratched into them are names, presumably of the workers. It is thought that these vessels were used by the men, and that they belonged to the factory mess hall. Forty-nine of them have been found, and the inscribed names have given the excavators a considerable clue as to the origins of the people in the town. Five carried the names of free Italians; twenty-eight, those of Italian slaves; nine were Greek; and seven had Celtic names, evidently belonging to the Noricans.

No More Floods For Noah

The fertile valley of the Tigris and Euphrates rivers in Iraq, believed by some authorities to be the site of the great flood of Biblical times and survived by Noah's Ark, will soon have a huge dam that will help prevent such floods in the future. Foundation excavation is now underway near Baghdad on the Diyala-Sirwan River, which flows into the Tigris, as well as preparations for divert-

ing the waters through two tunnels. These will later serve as permanent outlet works for a powerhouse. To be known as Derbendi Khan Dam, the rockfill structure will be used primarily for water storage and regulation for agricultural irrigation in these potentially fertile, but dry, plains. Flood control, which will somewhat reduce the storage benefits, and the development of hydroelectric power are of secondary importance.

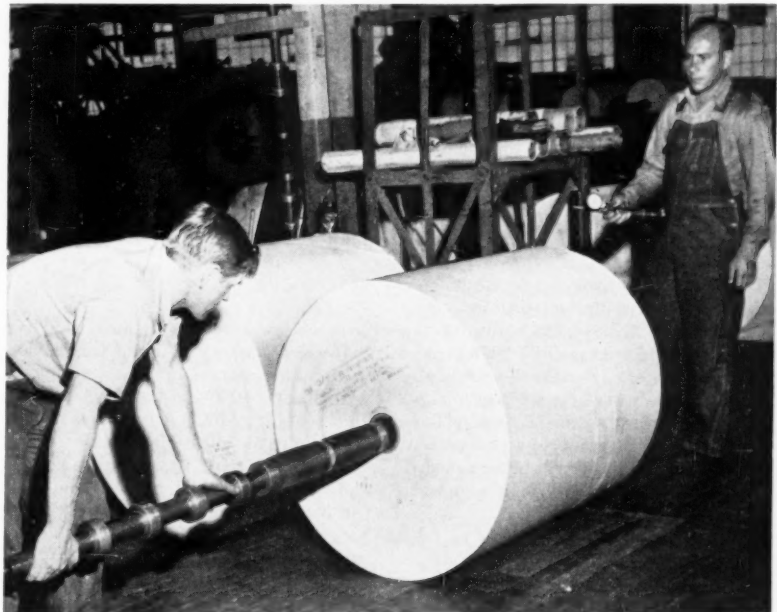
★ ★ ★

To Build An Interest In Science

To show that science can be fun, an interesting new booklet for young people and adults called *Adventures In Science At The Smithsonian* has been published by The Smithsonian Institution, Washington, D.C. It is profusely illustrated with full-page color pictures designed expressly to stimulate children's interest in science. However,

technical societies may find it useful as an educational public relations aid; scientists and engineers should find it helpful in explaining their work to the lay public; and private corporations may wish to distribute it to children of employees to stimulate student interest and to improve community relations.

According to the authors, E. John Long and George Weiner, the book was produced to encourage young people to consider the values of a career in the natural and physical sciences by making science an exciting series of "adventures," without sacrificing accuracy or dignity. Anthropology is covered in a section entitled "Searching for Cave Men"; astronautics, in "Conquering the Air"; engineering, in "Harnessing Power"; etc. Because of the arrangement of these sections, the booklet can be read from either front to back, or vice versa. In the former case, the reader will travel from the age of the dinosaur to the present; reading it in the other direction, he will begin with the tracking of earth



PNEUMATIC SHAFT FOR PAPER ROLLS

This photograph illustrates a pneumatic shaft that is helping Champion Paper & Fiber Company save money on paper-roll cores. Paper comes from the concern's Fourdrinier machines wound on paperboard cores. These are then unwound and the paper cut into sheets for books, magazines and the like. A steel shaft carries the weight of the roll as the paper is fed to the sheeting machine, and because of the need to brake the roll to provide proper tension, it and its shaft must turn as one. The usual method of locking the shaft to the roll consisted of keying the two together with bronze bushings. This cut up the ends of the cores so badly that one only lasted for two to three uses. The new shaft is essentially an undersized one around which is fitted a neoprene sleeve locked to collars. Air is admitted to the sleeve after insertion of the shaft in the roll, expanding it and locking the two together. Not only does the new shaft boost reuse of the cores to about a dozen times, but it is more easily and quickly installed. The device, as made by the Colguth Manufacturing Company, is adaptable to all roll widths from 20 to 75 inches—steel carrier rings, as shown in the picture, help support that part of the core not actually in contact with the expandable sleeve.

satellites, and move to the dawn of history.

The format of the 24-page booklet is such that the natural and physical sciences are separated. The brochure does not attempt to tell everything about all the fields of science; rather, it gives a glimpse at such specific fields as paleontology, anthropology, electromagnetism, aeronautics and astronomy.

★ ★ ★

Annual Drilling Symposium It has been announced that the Eighth Annual Drill and Blasting Symposium will be held at the University of Minnesota from October 2 to 4, inclusive. The meeting is sponsored jointly by the Colorado School of Mines, Pennsylvania State University and the University of Minnesota. According to the announcement, the principal topics for discussion include recent developments in drilling and blasting practices, problems associated with the use of drilling rods, and drilling and blasting research. Details of the papers to be given and additional information may be obtained from the Center for Continuation Study, University of Minnesota, Minneapolis 14, Minn.

★ ★ ★

Steel Work Begins On N.Y. Bridge The first major contract for a \$182 million 6-lane lower deck of the George Washington Bridge and its improved approaches in New York and New Jersey was awarded to Bethlehem Steel Company, Bethlehem, Pa. The contract, for \$13,610,298, calls for the furnishing and erecting of 13,875 tons of structural steel. Fabrication is beginning for delivery early next year.

The steel for the lower deck will be erected from barges below the present bridge. The addition will be attached to steel connecting plates that were pro-

vided at 60-foot intervals along the 4660-foot section between anchorages in the original structure. Completion of the steel erection is expected by December 1960, with the lower deck scheduled to be opened to traffic in 1962. At that time, it is estimated, the annual traffic capacity will be increased by 75 percent. Last year, the 8-lane bridge handled nearly 36 million vehicles traveling over the Hudson River between Fort Lee, N. J., and Washington Heights in upper Manhattan. The George Washington Bridge is the third longest suspension span in the world.

★ ★ ★

Tisit Cleans Lots

An outdoor vacuum cleaner called Tisit has been introduced by Michigan Production Engineering, Hazel Park, Mich. Powered by a Briggs & Stratton 4-cycle, 2¾-hp gasoline engine, this wheel-mounted cleaner may be used for picking up waste paper, leaves and all types of lightweight trash. It is particularly adaptable for use in parking lots, drive-in theaters, restaurants, zoos, parks, supermarket areas, airports, ball parks, race tracks, cemeteries, inside and outside factory areas, on large estates and institutions of all kinds. Because of the size and operating ease of the mobile unit, it is also practicable for use by home owners who have leaf-removal problems. The material picked up may be blown directly into inexpensive bags for disposal, or it can be blown through an attached flexible tube for deposit into reusable bags.

★ ★ ★

Record Capacity O₂ Plant

Linde Company, a Division of Union Carbide Corporation, is erecting a 1000-ton-per-day oxygen plant. Its capacity is equivalent to 730 million cubic feet of 99.5-percent pure oxygen per month, and will serve four U. S. Steel plants on the Monongahela River south of Pittsburgh, Pa.—Homestead; Edgar Thomson; Duquesne; and the National Works, National Tube Division. The Linde facility will be located at the Duquesne Works and will distribute oxygen to the other three mills by pipeline. Provisions are being made for an extension of the planned lines to a fifth location, the Carrie Furnaces. Last June, Linde put on stream a 500-ton-per-day plant, however its oxygen capacity, although equivalent to the entire estimated usage in the United States 20 years ago, will not be enough to handle the predicted future requirements at these four works. The use of oxygen has increased from 30 cubic feet per ton in 1950 to a present national average of 200 cubic feet of oxygen for every ingot ton produced.

About half of a steel mill's usage of the gas is in such established practices as scarfing, cutting and scrap preparation, while the other half is applied directly to the making processes. In more and more cases, the use of oxygen has become a low-cost alternative to building additional furnace capacity to meet the nation's demands for steel.

★ ★ ★

Air Strut Tent

Having a natural interest in camping and allied vacation activities, we were pleased to hear that lugging poles and cumbersome rigging may soon be completely eliminated. Quaker Rubber Division of H.K. Porter Company has developed a tent that can be erected and supported by air power. The design was made by R.A. Humphrys' Sons and looks much like a Quonset hut. Using Porter fire hose, a 1½-inch ID Buna S tubing, Quaker engineers sealed one end with an air valve. This hose is put into a jacket of cotton and Dacron for added strength and is sewn into the top and side portions of a tent. Depending on the size of the structure, hoses are positioned at three or more points. To set up the tent, the tubes are quickly inflated with a pump, and become rigid girders. Thus, tents are free of interior obstructions and are more roomy than conventional models of comparable size, making them ideal for hunting and camping trips.

★ ★ ★

Unique Weather Forecaster

Canada's first ice-forecasting service that provides information on the ice conditions in Canadian waters along the Gulf of St. Lawrence, Hudson Bay and Hudson Strait, went into operation this year under the direction of the Royal Canadian Navy. The service is a part of a mutual arrangement between Canada and the United States. In the past, similar forecasts for the central and eastern sections of the Arctic and for shipping lanes along the east coast to Baffin Bay were provided by the U.S. Navy Hydrographic Office, which is continuing to operate under the new arrangement to supplement information from the RCN. The service, to be called Sea Ice Central, operates from a headquarters at Shearwater, N. S., and has three, northern field stations. The first operates the year around, while the latter three—Churchill, Cambridge and Frobisher—operate alternately, in pairs, through the summer months, with basic ice information supplied from Shearwater. It is hoped that this service will eventually increase the length of the shipping season along the St. Lawrence Seaway.



"Oliver never lets you forget he helped build the George Washington Bridge!"

EDITORIAL

Cement



PORTLAND cement, perhaps because it is so common, is often overlooked as an important ingredient of our standard of living. This product, that enables us to make an infinite variety of inexpensive, durable stone creations, has many quirks: oftentimes it is cheaper than good topsoil; its chemical reactions of hydration, or setting, are not fully understood, although they can be closely controlled; the distributive costs of handling and transporting the product often total more than its cost of manufacture including the mining of raw materials; and it is the weakest part of the concrete it forms.

In 1957, the United States utilized more than 100 million tons of raw materials, ranging from natural cement rock to oyster shells, in the production of some 300 million barrels of cement. About 40 million barrels of capacity were added to this country's mills at an estimated cost of \$190 million. Also in 1957, supply caught up with and exceeded demand—a rare condition in the postwar market. Planned expansion for the current year, if fully carried out, will add another 25 million barrels to the annual mill capacity, yet industry forecasters predict that even this added supply will be insufficient to meet the demands of 5 years hence.

WORLD production of cements is about four times the United States' total, with this country leading all others in production. The Soviet Union, according to government estimates, comes in a poor second, followed by West Germany and the United Kingdom. International movements of cement amounted to less than 1 percent of total production, largely because of the expense of transporting the bulky product.

POWER is a prime ingredient of cement. Exclusive of transportation fuels and explosives, it required, in 1953, 8.36 million short tons of coal, 6.71 million barrels (42-gallon capacity) of oil and 117 billion cubic feet of natural gas to produce the 264 million barrels of cement turned out that year. In addition, the industry utilized 5508 million kilowatt hours of electricity, of which 38 percent was generated by the mills, and 62 percent was purchased.

BARRELS, as units of measure in the cement industry, are a relic of early days in the field when virtually all cement was shipped in such containers. Today, almost 70 percent of the

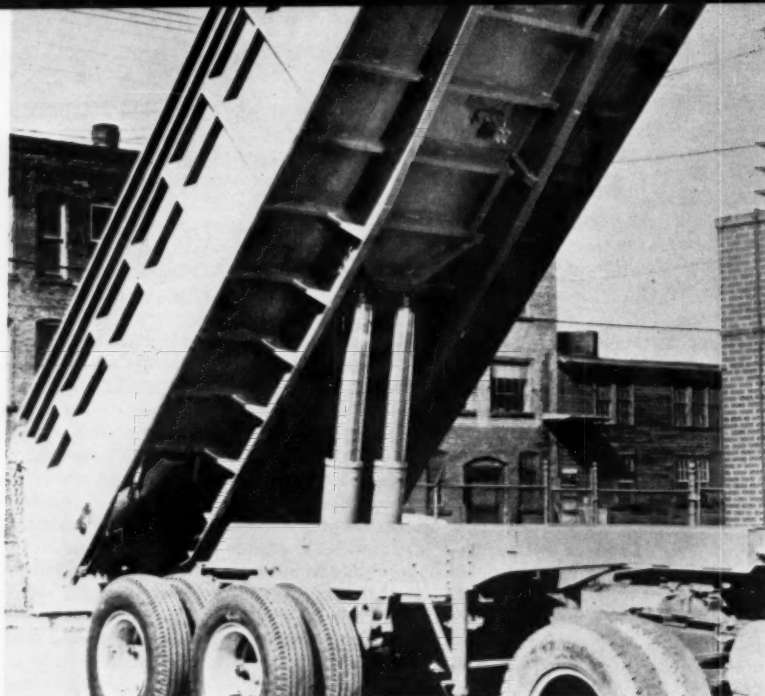
total production is shipped in bulk in railroad and truck hoppers. Virtually all the remainder is packaged in paper bags. (The 94-pound capacity of these bags is a mystery to many people who wonder why a unit of 100 pounds might not be more convenient. The answer is reasonable—94 pounds is the weight of 1 cubic foot of most cements; and, because concrete mixes are prepared on a volume-ratio basis, the standard sack is more convenient than a 100-pound bag would be.) Shipments of cement in cloth bags, once holding more than half of all production, is now less than 0.5 percent, and the quantity put up in barrels, less than 0.05 percent.

MINING is an important phase of the cement-making process. It requires 640 to 650 pounds of raw materials—excluding fuels—to make a 376-pound barrel of finished cement. Of the stone and other products used in cement manufacture in this country, limestone and such lime-bearing substances as oyster shells are the most important, followed by cement rock, clay and shale, gypsum, blast furnace slag, sand and sandstones, marl, iron-bearing substances and other miscellaneous materials including fluorspar, flue dust, pumicite, pitch, red mud and rock, hydrated lime, tufa, calcium chloride and air entraining compounds.

Prior to 1905, more than 50 percent of the nation's supply of portland cement was made of cement rock and pure limestone; about 30 percent, of limestone and clay or shale; some 10 percent, of marl and clay; and about 5 percent, of blast furnace slag and limestone. Recent figures reveal that only about 20 percent of today's supply is made from cement rock; more than 50 percent is a combination of limestone and clay or shale; less than 2 percent is formed of marl and clay; and about 8 to 10 percent makes use of blast-furnace slag.

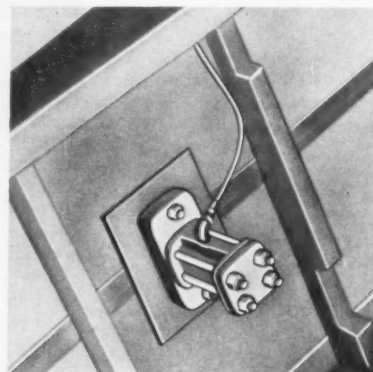
Water is also an important ingredient, about two-thirds of the plants in this country utilizing the so-called wet-slurry process to produce approximately 55 percent of the total supply.

CEMENT manufacture is another of the important industries of the nation that would be hard pressed to operate without extensive use of compressed air power. From the mines and quarries where raw materials are garnered, to the giant kilns and crushers of the mills, air-powered rock drills and maintenance tools aid in the reduction of costs. Pneumatic conveying of cement is a rapidly growing technique, as is the fluidization of cement in transport cars to aid in its removal to bulk storage bins. Pumps and vacuum equipment also are vital to the industry.



NOW ON TRUCKS

The dump truck in the photograph at the left is equipped with a vibrator located near the top of the section that is lifted highest. It can be seen in the center square on the underside of the trailer. (A close-up view is shown in the other illustration.) These units use air at a pressure of 80 psig which is drawn from a reserve tank.



TRAILERS USE VIBRATORS TO EMPTY LOADS EFFICIENTLY

LONG used on conveyors, Cleveland Vibrators are now being added to dump trailer trucks manufactured by The Truck Engineering Corporation, Cleveland, Ohio. Operating from the vehicles' air brake systems, they shake loose cargoes by rapidly jarring the whole trailer.

These vibrators have dual functions: they ease the handling of naturally stubborn materials, such as wet clay or dirt; and they make the dumping of material under adverse climatic conditions more efficient. With the units, even stone or coal that retains moisture and freezes to

the sides of trailers in cold weather can be shaken loose.

The Cleveland vibrators operate at 80-psig pressure which is supplied by the air brake line and a reserve tank. On the truck illustrated here, a control valve for the vibrator is installed by the end gate. On hopper bottom trailers, the operating valve is so positioned that the units start when the hopper is opened. TEC trailers use one 2-inch vibrator centered on the bottom near the front of the trailer body. Occasionally, two vibrators are installed, with the second being located toward the rear of the body. On

hopper trailers, one 2-inch vibrator is mounted on the side of the hopper.

The unit consists of a simple pneumatic cylinder and piston. As air is introduced from the brake system, the piston vibrates back and forth, setting up vibrations throughout the whole trailer body. According to TEC, no damage is caused to the trailer body, and the vibrator itself has caused no maintenance problems for the past 2 years. It is said that these units can be installed on any truck—all that is needed is a bit of tubing, a reserve air tank and a vibrator.

TWENTY YEARS WITHOUT MAINTENANCE

ARECEIVER-MOUNTED air compressor in Ralph's Service Station, Norwalk, Conn., is a real old-timer; the machine has delivered air since 1935 without ever being overhauled. This commendable record has been established by an Ingersoll-Rand 1-hp, 2-stage

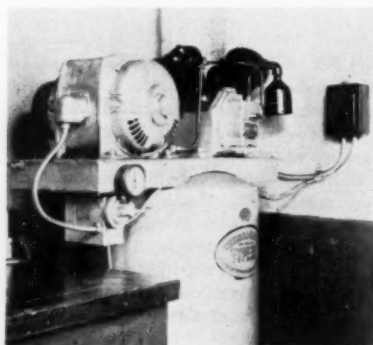
Type-30 compressor, and the only part that has been replaced is the V-belt drive.

The life of the unit has not been an easy one, either. The modern service station uses compressed air for almost unlimited applications. This compressor supplied air on an automatic pressure-regulated cycle for tire work, a hydraulic lift, spark plug cleaning, air-powered grease guns and many other purposes. Even in 1935, this efficient compressor

was one size smaller than competitive units recommended to operate all this equipment.

Several construction features are said to have contributed to its long life. A centrifugal unloader automatically unloads the unit when it stops. This prevents motor overload during starting and protects the working parts. A finned intercooler between the two stages cools the air and helps prevent carbonizing of valves. Stainless steel finger valves, unaffected by corrosive and moist air, give the flexural strength needed to resist fatigue.

After 20 years of service, the compressor is still delivering compressed air efficiently. When removed from Ralph's Service Station during a recent modernization program, the compressor was reinstalled in one of the leading automotive dealerships in Massachusetts. It is said to be still functioning perfectly.



OLD-TIMER

This Ingersoll-Rand Type-30 compressor has been on the job since 1935 in a Connecticut service station and has never been overhauled. The 1-hp unit has been used for many hours daily to supply air for hydraulic lifting, tire work, spark plug cleaning and air guns. The only replaced part on the machine is the V-belt between the motor and compressor.

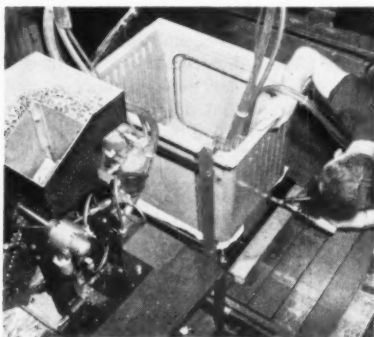
NEWARK Stove Company of Ohio has reported saving 8 minutes in the total time required to drive the screws in each electric stove it produces. The company manufactures Kenmore ranges for Sears, Roebuck & Company, and is achieving the time reduction by using nine, air-operated, automatic feeding devices manufactured by Parker-Kalon Division of General American Transportation Corporation. Since the units have been in operation, virtually all manual handling of the 51 screws needed in assembly and subassembly work has been eliminated.

The feeding units, called Jet-Setters, deliver screws, either with or without preassembled self-locking washers, from hoppers to air-operated screwdrivers. They are located at nine stations along a platform conveyor. At each of these positions, only one man is required for the operation. Each device is equipped with an automatic control that permits the feeding of screws from the supply hopper to the driving head, one at a time. After each fastener has been run, the next is automatically blown through a tube to a 3-jawed, screw-holding mechanism where it is gripped in a manner similar to that used by a drill chuck, ready to be run. The screw thus acts as a finder, or drift, and each is started and driven in one operation.

At each station, 12-foot hose lengths are used so that the workman has maximum flexibility in moving the screwdriver to any required position for any set of assorted operations along the moving assembly line.

At the first station, an operator drives two screws to attach a service lead support, or connection box, to the stove's back. This is done in a vertical jig with the range in the back-upright position; the driving is done downhand. The oven is then turned to a horizontal position and placed on a wooden assembly skid. A blanket of insulation is applied to the back and the unit is moved to Station 2.

There, a second Jet-Setter unit is mounted on a special welded steel stand,



as can be seen in the photograph reproduced above. This platform was devised by Newark Stove for use alongside a

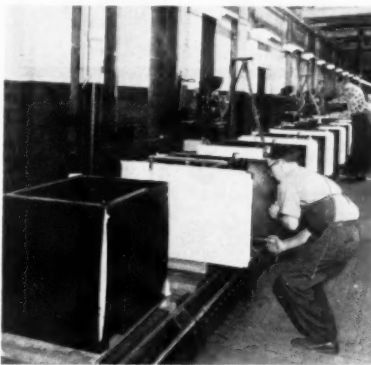
SAVING WITH AIR POWER

STOVE ASSEMBLY

moving assembly line, such as the one being described. Four screws, without washers, are driven at Station 2 to fasten the oven to the range back. This operation is also performed downhand.

The third Parker-Kalon unit with its pneumatic screwdriver operates at a subassembly location from which end panels are delivered in racks to the principal assembly line. At this subassembly, enameled panels are placed in a horizontal jig, and a pair of automated horizontal tappers make leg-leveling holes. The worker then uses the Jet-Setter to run five screws and their preassembled washers.

At Station 4, the end panel assemblies are positioned, six screws with preassembled washers being driven through holes in the oven's bottom support into



the stove's front, back, right and left end panels. The same assembler installs the two slides for the drawer, driving one screw through the front of each slide into the end panel. The photograph above, taken at Station 4, shows the conveyor-line set-up used to manufacture the Kenmore units. The ovens are turned onto their backs as they move towards the operator in the foreground. Two of the Jet-Setter rig stands can be seen behind the line. All component parts are delivered to the assembly station, just out of sight to the right of the illustration, on special skid racks. In this way, the required materials and parts are within easy reach, helping to reduce the over-all assembly time.

The fifth Parker-Kalon unit is at Station 5 and is used to drive four screws that hold hinged cams to the oven door liner.

As the Kenmore units arrive at Station 6, the operator places the oven door insulation. A door panel is slipped over the liner so that the top is locked in place before three screws are run at the bottom of the door panel. Immediately following this operation, the range is placed on a lightweight rectangular wooden frame that later becomes the base for a shipping carton.

At the seventh station, the Jet-Setter is equipped with a collet head because of a limited clearance in the area where the screws must be driven to the oven's top insulation liner. The picture below is



a close-up view of the air-operated screwdriver being used to place 10x5/8-inch screws. Five of these, with preassembled washers, are used to hold the top liner to the end panels. It is clearly shown that the holes through which the screws must be driven are close to the sides of the Kenmore range. Three of the five fasteners are driven downhand, and two are driven horizontally into the end frame corners. The worker at Station 7 must also place three more screws and washers to hold the top of the oven door liner, install the insulating blanket on the oven top and set the preassembled range top and burners into position.

The workman at Station 8 drives two screws, again with preassembled washers, to connect the main top to a rear gusset; installs four more fasteners to hold two backguard support brackets in place; a seventh for the ground strap and an eighth fastener for the ground wire.

The final operation, at Station 9, requires the placing of four screws and their preassembled washers to fasten the backguard brackets to the backguard. Once they are in place, the employee positions the control panel behind the range in preparation for crating. The wooden bases, that became a part of the moving workpieces at Station 6, now form the base of each package. By the time the Kenmore ranges have reached this position, the manufacturer estimates that approximately 8 minutes of assembly time have been saved on each unit. In the final analysis, this decrease in time provides not only a financial saving for Newark Stove Company, but for Sears, Roebuck & Company and its customers. Subsequently, it has been possible to improve design and quality in the Kenmore line without an appreciable increase in price.

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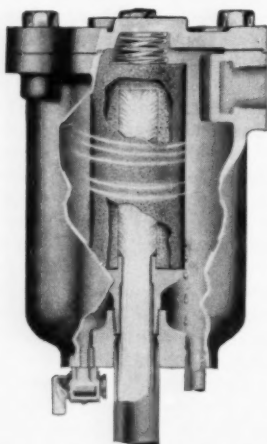
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ADAMS PORO-STONE AIR FILTER

designed to remove oil, water and foreign matter from compressed air lines with minimum pressure drop.



The R. P. Adams Poro-Stone air filter is engineered to efficiently remove entrained oil, water and pipe scale from compressed air lines. Liquid

droplets and solids being carried by the gas stream are first removed by centrifugal action in an annular chamber. Secondary filtration is achieved by passing the air or gas stream through a Poro-stone unit. An automatic trap can be provided to discharge the residue from the cyclone chamber.

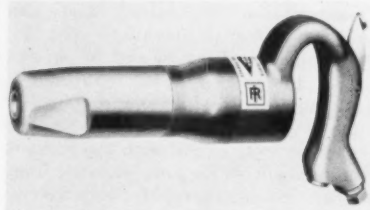
At rated capacity the filters operate at a maximum pressure drop of only 1/2 lb., thus insuring delivery of line pressure to the point of consumption.

The units require virtually no service or maintenance—thereby insuring continued trouble-free, low cost performance.

ADAMS Poro-Stone air filters are available from stock in sizes to suit your needs. For further information, write today for Bulletin 117, R. P. Adams Co., Inc., 209 East Park Drive, Buffalo 17, New York.

Industrial

CHIPPING hammers, with rubber-bonded Shock-Absorber nozzles and controlled power valves to allow tailoring of the power of the units to the exact job requirements, have been announced by Ingersoll-Rand Company. Each tool re-



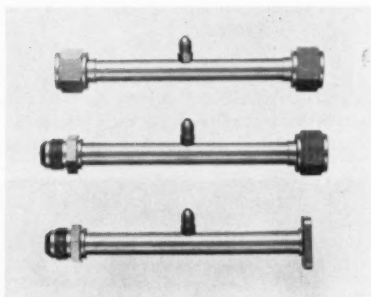
portedly absorbs chisel vibration, provides new comfort and efficiency for the operator, substantially reduces noise level and eliminates breakage of parts caused by improper operation. Each pneumatic unit can have any of three types of handles—standard, open handle and outside trigger; open handle with outside trigger and advanced air inlet; or open handle with inside trigger and advanced air inlet. Four power sizes are available for each hammer size: "L" for light cuts; "N" for normal cuts; "E," extra cuts; and "S" for super cuts. The hammers are available in five models, thus making a total of twenty graduated units from which to select the tool most appropriate to the requirements of each operator and his particular job. The conversion of a given hammer to any of the four power ratings is easily accomplished by changing the valve box cap. These pneumatic tools also feature a plating of certain parts with IRamet, a chrome plate specifically processed and heat treated to provide a long-wearing surface. Thus, it is said that these units are resistant to chipping and flaking. Ingersoll-Rand Company, 11 Broadway, New York 4, N.Y.

OIL LEVEL in an automatic oiler for pneumatic tools can be easily checked through a mid-section sight gauge on units called Inject-O-Mist. It is said that the oiler can be used on any small portable tool that operates on intermittent air pressure. The device breaks the



lubricant into a microscopic mist and injects it with each impulse of air, protecting the tools from moisture, friction and wear. A screw adjustment controls the amount of oil used. Because the end bells are of anodized aluminum and the sight gauge is of lightweight Tenite butyrate, the total weight of the oiler is so minimized that it can be attached either directly to the pneumatic tool or on a short pigtail without interfering with normal operations. *Carlson Products, Inc., 5309 North Twenty-fourth Street, Omaha 11, Neb.*

MEASURING sections of stainless steel, with smooth inside finish and close tolerances of eccentricity, are said to assure accurate readings of temperature and pressure instrumentation. Tests indicate that angularities of the measuring holes with the flow streams, burrs in the pipe or improper hole size can produce errors of 15 to 20 percent of dynamic head. It is said the precision fabrication



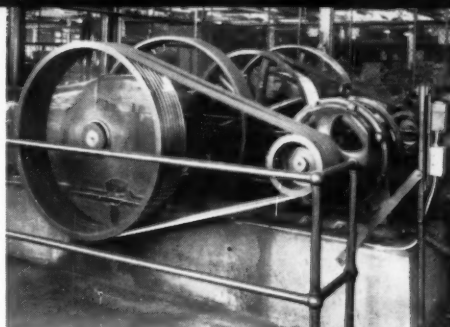
of the measuring sections eliminates these errors. Sizes available range from 1/4 to 2 inches OD, with working pressure ratings to 5000 psig. Lengths available conform to American Society of Mechanical Engineers (ASME) Power Test Codes and Aviation Industry standards, and the sections may be obtained with male or female AN tube connectors or flange ends. Straight sections containing both a pressure take-off and a thermocouple probe connector are also available. *Kahn & Company, Inc., 547 Windsor Street, Hartford 1, Conn.*

AIR HOSE of nylon, for use with pneumatic tools, incorporates snapback action to keep it out of the way of work. Nycil hose is said to be tough, heat resistant and unaffected by oil, kerosene and gasoline, and is recommended for industrial plants, machine shops and gas station lubrication rooms. Reportedly, the tubing has a long service life and will withstand high operating pressures as well as, or better than, rubber hose. Its abrasion and chemical resistance are

"POWER KING"

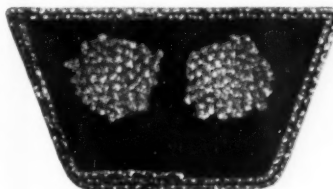
The V-BELTS With Greater Capacity for Heavier Loads

Fewer Belts Needed for Any Drive



Because they are built with larger, stronger, endless twin grommets having 40% more tensile strength than others of their type, "Power King" V-Belts transmit greater H.P. This means, on any drive, fewer belts, reduction in over-all weight and less space required for a given load. They are the only high capacity V-Belts with so little stretch that the efficiency of the drive is not affected.

BETTER GRIP. Because of their greater flexibility, "Power King" Grommet V-Belts have one-third more gripping power than other types, and therefore pull heavier loads. They are cushioned against impact, with the rubber body surrounding the grommets acting as a shock absorber. This solid mass of heat-resistant rubber also serves to prevent penetration of moisture to the twin grommet reinforcement.



The twin grommets in "Power King" V-Belts are endless... no intermediate overlapping or splicing. That's why these belts are much stronger, stretch less, carry greater loads and last 20 to 50 per cent longer.

Switch to "Power King" V-Belts, and note the savings they assure through increased capacity, greater efficiency and longer service life.

"If it's GOODALL, it MUST be Good!"

Contact Our Nearest Branch for Details and Prices

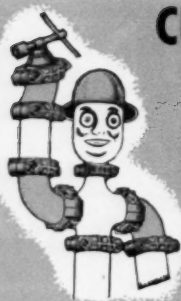
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BRANCHES AND DISTRIBUTORS THROUGHOUT THE UNITED STATES.
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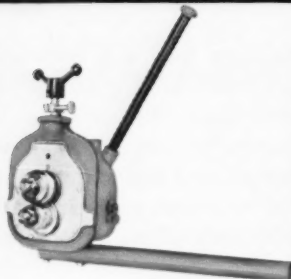
CUT COSTS WITH THE NEW VIC-EASY® METHOD OF JOINTING LIGHTWEIGHT PIPE

SAVE UP TO 60% IN PIPING COSTS!

Now there's no need to buy overweight pipe. Thanks to Victaulic engineering, you can select lightweight pipe "job-rated" to your conditions and install it the new VIC-EASY way. You'll cut costs of pipe, transportation, and handling—you'll save from 30% to 60% in man-hour installation.



1. LIGHTWEIGHT PIPE in thicknesses from .065" handles high pressures. Leading mills make sizes 1 1/4" to 12", steel or aluminum, with VIC-EASY roll-grooved ends.



2. VIC-EASY PORTABLE GROOVER rolls grooves into pipe in seconds. Manually or power-operated, this groover removes no metal...retains full wall thickness.



3. VICTAULIC SNAP-JOINT COUPLING assembles and locks by hand—no wrenches or tools required. Other bolted styles of Victaulic Couplings alternately usable.

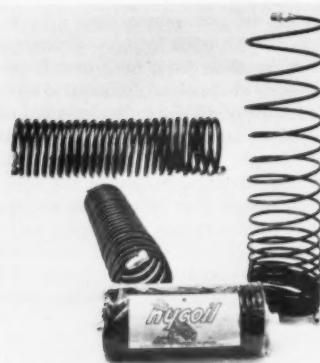


4. VICTAULIC FULL-FLOW FITTINGS team up with our couplings and lightweight pipe to provide a complete VIC-EASY system...cuts costs of installation and operation.

For complete information write for Bulletin BB-8.

VICTAULIC COMPANY OF AMERICA
P. O. BOX 509 • Elizabeth, N. J.

said to be superior, and its smooth inside surface insures less resistance to air flow.



The coiled form in combination with a portable attachment provides flexibility and mobility for use with portable pneumatic equipment, such as air tools, air staple guns and spray guns. It is said to be especially useful for overhead work. Nycoil is offered in 3/8- and 1/4-inch ID sizes, in a standard 25-foot length, with flare fittings on each end. Shorter lengths may be cut and flared with a standard copper flaring tool. *Nycoil Company, Westfield, N.J.*

ENGINEERS and plant or office executives may find useful a circular, pocket-sized slide rule designed for perform-



ing simple calculations. Operation of the rule is easy and results are accurate—multiplication, division and proportions may be carried out. Instructions are included. The slide rule may be obtained free by engineers and business executives; others may receive it by sending \$0.50. *General Industrial Company, 5738 Elston Avenue, Chicago 30, Ill.*

AIR-POWERED pumps of stainless steel permit minute-quantity or volume delivery of fluids directly from original shipping containers. Powerfloes, as they are called, are designed for pumping adhesives, foods, pharmaceuticals, inks, dyes, alcohols, ammonias, soaps and many other liquids and semifluids. The lower assembly of each unit is easily removed from its power head, reportedly without the use of tools, for complete

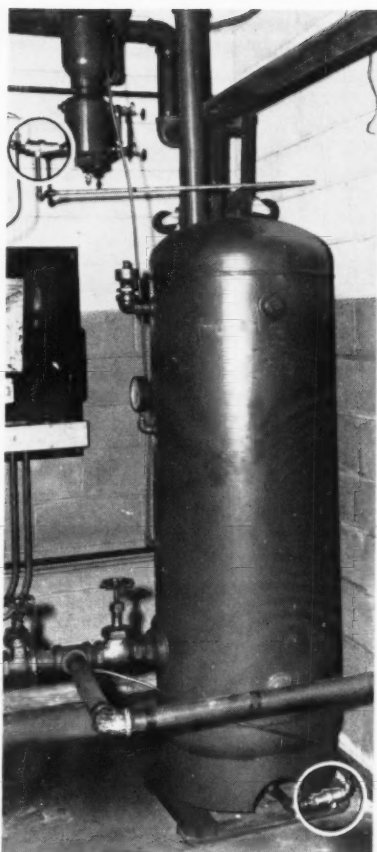


Illustration shows two series 1000 GEORGE automatic ejectors one on the separator and one on the receiver—a successful application. All air devices WORK BETTER and LAST LONGER when supplied with clean, dry air.

for AIR COMPRESSORS HAND DRAINAGE is NOT ENOUGH

PREVENTATIVE MAINTENANCE

begins at the compressor by the regular automatic removal of the water, oil, carbon and sludge from the receiver every time the compressor starts and stops or the governor operates. Hand drainage is not enough.

Literature on request.

GEORGE
MANUFACTURING CO.
10-16 W. Harvey St.
Phila. 44, Pa.

cleaning. Its air-operated power head eliminates any danger of sparking and produces equal delivery on both up and



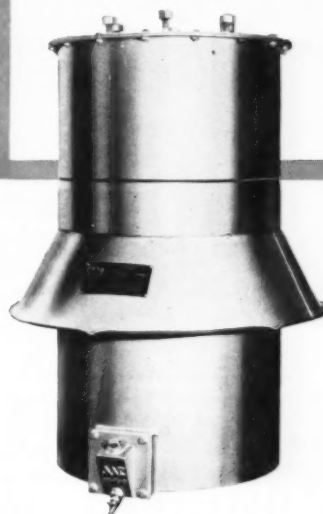
down strokes for smooth, continuous flow without pressure on the drum. Delivery rate is controlled by merely opening or closing a valve at the hose outlet. Gray Company, 1016 Sibley Street NE, Minneapolis 13, Minn.

SLACKLINER cableway bucket design allows the unit, it is said, to be lighter in weight for a given strength and require less line pull than other buckets of the same rated capacity. The bucket has a continuously curved cutting edge designed to quickly penetrate hard-digging material and move it into the bucket with minimum resistance. Reportedly, this curve also gives more tension at the cutting edge and much less bending stress. The units have a completely welded assembly. Rolled high-strength



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AAF Cycoil Oil Bath Air Cleaners Give Positive Protection



AAF Type "W" Cycoils have proved themselves in thousands of installations—even where dust conditions were most severe. High collection efficiency and virtually maintenance-free operation have made Type "W" Cycoils favorites in all industries.

The operation of the Cycoil is unique. A combination of oil impingement, centrifugal action, and filtration results in practically 100% dust removal in standard A.S.H.V.E. tests. Would you like more information? Write for our illustrated catalog.



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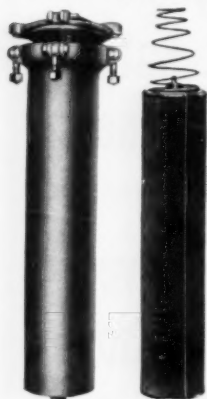


Fig. 1555BF Duplex Filter uses factory packaged laminated fiber disc filtering elements. Each filter comprising duplex operates independently or in parallel. Wide range of sizes.

AT LEFT: Fig. 1555-4L Filter and laminated disc cartridge. High flow rate; low pressure drop. Excellent micron efficiency. Cartridges interchangeable with all other Nugent Bag or Depth Type cartridges.



Fig. 1576 Bag-Type Pressure Filters feature inexpensive, completely disposable filter cartridges. For filtering fuel oil, lubricating oil and wide variety of fluids.

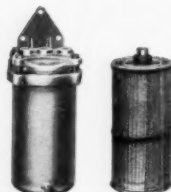


Fig. 1490AM-0 star-shaped extended area strainers offer increased free screen area over round basket type.

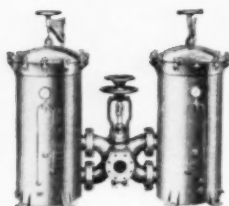


Fig. 1554AN-4L7 Duplex Strainers provide the advantage of uninterrupted flow, without by-passing, while cleaning the strainer baskets. Each strainer comprising duplex uses 7 strainer baskets Fig. 1554A-4L.

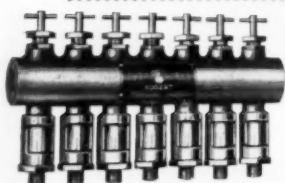


Fig. 1503F Multiple Pressure Oilers are available with from 2 to 24 feeds.

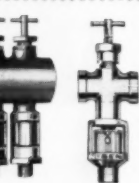


Fig. 524 Sight Feed Valves with removable glass. 1/4" to 3/4" IPS.



Fig. 1575 Pressure Sight Flow Lubricator. Single units or multiples to 15.



Fig. 1366E Sight Flow Fittings for indicating flow of liquid in a pipe line. Available in brass, cast iron, steel or stainless steel.

Valuable equipment deserves the best possible protection that can be provided. Nugent offers a complete line of filters, strainers and lubrication specialties for this purpose. All are backed by the experience and know-how gained through solving industry's problems in this field for more than 60 years. For bulletins giving complete information on any or all Nugent products, call or write today.

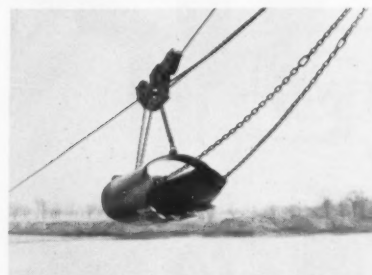


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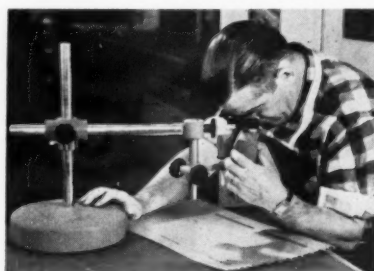
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SIGHT FEED VALVES • FLOW INDICATORS

steel plates are utilized throughout, along with integral tooth bases. Sizes



available include 1, 1½ and 2 cubic yards. *Sauerman Brothers, Inc.*, 648 South Twenty-eighth Avenue, Bellwood, Ill.

TWO SETS of objectives on a rotating turret come with Edmund Scientific's Stereo Microscope. Up to 3 inches



of working distance is provided for the instrument which has wide-field eyepieces giving 23- and 40-power magnification. A heavy base allows the microscope to swing around, move up and down, or rotate on its axis, maintaining a vibration-free image. Total horizontal travel is 360 degrees, moving 11 inches toward and away from the support post. Vertical travel is 14 inches, and the scope may be locked at any angle with large plastic knobs. *Edmund Scientific Company*, Barrington, N. J.



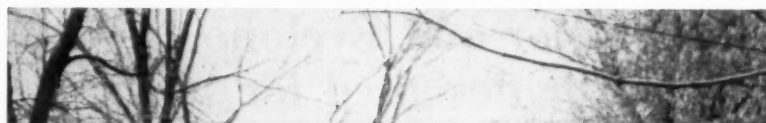
"Time hanging heavy on your hands, boys?"

**Industrial Literature,
Books and Films**

CARGO PUMPS of the single-stage type, offered in a capacity range of 2500 to 7000 gpm, are described in Ingersoll-Rand's recent flier, Form 7493. The manufacturer states the units are built to move maximum tonnage in minimum time. The pumps are dual-volute, horizontally split units with double-suction impellers, balanced both mechanically and hydraulically. Bearing housings are water-cooled to assure low bearing temperatures when the liquids being handled are hot. Suction passages, designed for smooth flow of liquid to the impeller, contribute to high-speed cargo discharge. The flier contains a cross-sectional view of the pumps' design and gives detailed construction information. *Ingersoll-Rand Company*, 11 Broadway, New York 4, N.Y.

VARIOUS types of construction, high lighting the need for engineers in the field, can be seen in *The Constructors*, a color motion picture distributed by The Associated General Contractors of America. Basically designed to interest students of junior and senior high school age in engineering while they are young enough to take the proper preparatory courses, the 17-minute, 16-mm film also is used by AGC chapters to promote interest in construction among civic, veteran and union groups. From preliminary showings, the film appears to have the same compelling interest that draws sidewalk superintendents to construction sites. From its opening blasting scene, it moves rapidly through such fascinating activities as swinging sections of high bridges into place, boring tunnels through mountains, clearing forests and catching hot rivets while on towering steel beams. In addition to seeing the fascination and romance of the construction industry, the student is told that he has to begin preparing early, if he hopes to achieve the position of an engineer in construction. He is advised, generally, of what subjects would be most valuable in such a specialized career. It is pointed out that the same courses required for construction employment will prepare the student for any other field of engineering science. *The Associated General Contractors of America, Inc.*, Munsey Building, Washington 4, D.C.

A **FILTER** engineering and application reference manual can be obtained by writing on company letterhead to Bendix Filter Division. This 132-page, profusely illustrated book is one of the most complete and deals with filters for aircraft,



Another Winning Combination



Ingersoll-Rand COMPRESSOR

...and **CONTINENTAL RED SEAL POWER**

Year after year, Continental's famous dependability goes on building product acceptance for leading manufacturers of equipment. Here, for instance, an Ingersoll-Rand 85-cfm Rotary Compressor with Continental F-140 engine operates a PB8A Paving Breaker, using moil points, clay spades, and tamping bits, on a job in upstate New York. You cut costly down-time . . . do more work . . . with dependable Red Seal power.



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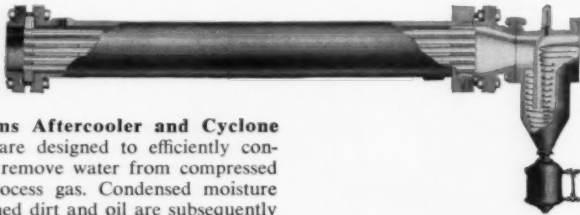
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CONTINENTAL IS ON THE MOVE IN 1958

Aftercooler and Cyclone Separator designed for cleaner, dryer compressed air

R. P. ADAMS CO., INC.
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The Adams Aftercooler and Cyclone Separator are designed to efficiently condense and remove water from compressed air and process gas. Condensed moisture and entrained dirt and oil are subsequently removed in a cyclone type separator. This unit is scientifically designed for maximum removal efficiency over a wide range of flow rates.

For normal use, units are available to cool gases to within 10° F of the temperature of the cooling water. Specially designed units are available to permit a 2° F approach to cooling water temperature, for application where low moisture content is critical.

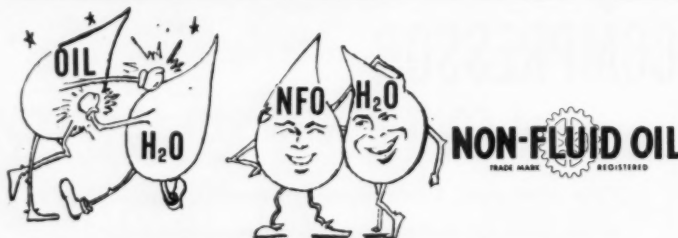
Adams Aftercoolers and Separators are available from stock to handle 20 - 40,000 cfm with 10° cooling and 25 - 19,200 cfm

where it is necessary to cool within 2° F of the cooling water. Special units can be supplied to suit an unlimited range of requirements. In all cases the maximum pressure loss at rated capacities is ½ psi.

This wide range of sizes enables the economical utilization of Adams Aftercoolers and Separators in virtually all industrial application. For further information on how R. P. Adams' units will solve your compressed air problems and save you money, write today for Bulletin 711.

missile, industrial and ground support equipment. Filters for lubricating oils, gasoline, jet fuels, hydraulic fluids, compressed air, gases, de-icing fluids, air conditioning systems, test stands and refueling installations are described and illustrated in considerable detail in a 112-page product section. Fourteen pages in the front of the booklet give a brief history of the art of filtration; subject, quick-reference and numerical parts indexes; a discussion of particle sizes; and basic filter media. Engineering specifications including components and parts numbers, flow curves, capacities and sizes, exploded views and cross-section drawings are given for the nearly 30 different types of filters and filter elements discussed. *Bendix Aviation Corporation*, Bendix Filter Division, 434 West Twelve-Mile Road, Madison Heights, Mich.

AIR-MOTOR-OPERATED lubricant pumps are discussed from design and engineering points of view in a recently published catalogue (No. 65). Lubricant-output-performance and selection charts about the Lincoln Power-Master Series, complete this brochure. This is the latest addition to the line, and according to the manual, the 67 pumps in it are available in nineteen pressure ratings. *Lincoln Engineering Company*, 5703-32 Natural Bridge Avenue, St. Louis 20, Mo.



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Don't tolerate worn, rusted pneumatic tools! Since you can't "lick" the ever present moisture in compressed air, why not join it? Our new "NR" Grades of NON-FLUID OIL absorb this moisture into the Lubricant, forming a stable emulsion. "NR" Grades of NON-FLUID OIL provide these extras:

- Perfect lubrication.
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NON-FLUID OIL is approved by all leading manufacturers of air tools and used by the majority for initial run-in after assembly. You will see why if you write for a free testing sample and Bulletin 550.

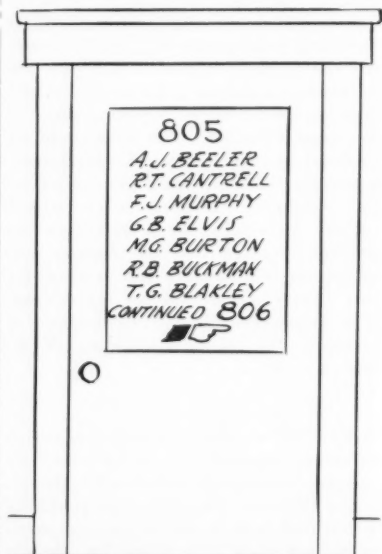
NEW YORK & NEW JERSEY LUBRICANT COMPANY

292 Madison Ave., New York 17, N. Y.

WORKS: NEWARK N. J.

Birmingham, Ala. Columbus, Ga. Greenville, S.C. Springfield, Mass. Detroit, Mich.
Atlanta, Ga. Charlotte, N.C. Chicago, Ill. Greensboro, N.C. Providence, R.I.
St. Louis, Mo.

FILMSORT is a system for filing engineering drawings. *The Filmsort Aperture Card for Your Engineering Drawings and Allied Record* is a 16-page brochure that traces the basic procedures in transforming an original drawing to a frame of microfilm; inserting the film into an aperture card; viewing and enlarging the



film from the card, and the use of new techniques, such as electrostatic printing and dry-copy contact printing of film, in one card, onto film in another. *Film-sort Company*, Pearl River, N.Y.

TECHNIQUES that make welding of aluminum simple and practical are demonstrated in a 33-minute, full-color sound movie recently produced. It shows that aluminum is easy to join by welding, brazing or soldering, although the techniques are different from those used with other metals. Animation is used to help make the technical presentation simple and interesting. The

16-mm film, entitled *Aluminum Welding . . . Different, Not Difficult*, is available to business firms and interested organizations. A 28-page technical brochure is also supplied to supplement the information in the movie. *Reynolds Metals Company*, Advertising Distribution Center, Richmond 18, Va.

A COMPILATION of American Society for Testing Materials (ASTM) standards, entitled *Steel Piping Materials*, contains all the specifications for carbon- and alloy-steel pipe and tubing issued by the group. Included are specifications for pipe used to convey liquids,

vapors and gases at normal and elevated temperatures; still tubes for refinery service; heat exchanger and condenser tubes; boiler and superheater tubes and the like. To make the volume more complete, there are also included specifications for each of the following materials used in pipe and related installations: castings, forgings, bolts and nuts. In all, there are 62 standards, of which 26 have been recently revised or have had their status changed within the year. Two standards are new. This compilation replaces the March 1957 edition. Cost, \$5.00. *American Society For Testing Materials*, Headquarters, 1916 Race Street, Philadelphia 3, Pa.

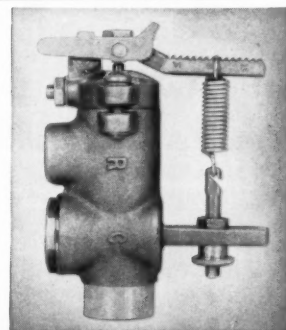
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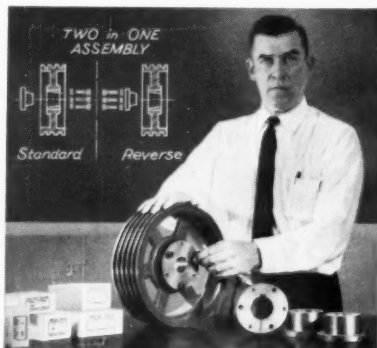
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When it's "Sure-Grip," of course. As many as 32 "Sure-Grip" bushings will fit the sheave illustrated above. Each permits the use of the sheave on a shaft of different size. Not only that, but in almost every case "Sure-Grip" bushings are drilled and tapped to permit sheave mounting from either side. Add to this flexibility the extra performance that's built into Wood's sheaves and the matchless quality of Wood's matched "Sure-Grip" V-belts and you have an outstanding solution to your drive problems. For information regarding specific drive applications and your copy of Bulletins No. 599 (sheaves) and 3100 (belts), write:

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There are no projections to catch or snag. Punch-Lok's double-wrapped steel band and "lok" are flush with the surface of the hose. Uniform clamping action compresses the hose evenly all around the fitting to secure a leakproof connection stronger than the hose itself.

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TAMPS 3500 FEET IN 6 HOURS

with two GM Diesel-powered
Tie Tampers

The C&O Railroad started using GM Detroit Diesel power in maintenance-of-way equipment in 1947. First engine was in a ditcher. Today the railroad has 28 of these fast-stepping 2-cycle Diesels powering a crane, ditchers, tampers, ballast distributors, dozers, carry-all scrapers and air compressors.

Shown here are two Matisa Tie Tampers, each propelled by a GM "4-71" Diesel which also drives equipment-mounted Ingersoll-Rand compressor to operate tampers. Following ballast distributors to compress ballast under ties for a solid road bed, these two units working together cover up to 3500 feet of road bed in six hours.

The versatile GM Series 71 Diesel offers the same unique features of standardization and parts interchangeability as the "567" locomotive engine. One cylinder assembly fits all units from 2 to 24 cylinders—a single inventory of basic parts protects all engines from 30 to 893 h.p. GM Diesel power is the choice of leading railroads in both on- and off-track equipment because *it does more work at less cost!* Get full details from your GM Detroit Diesel distributor, or write us.

DETROIT DIESEL



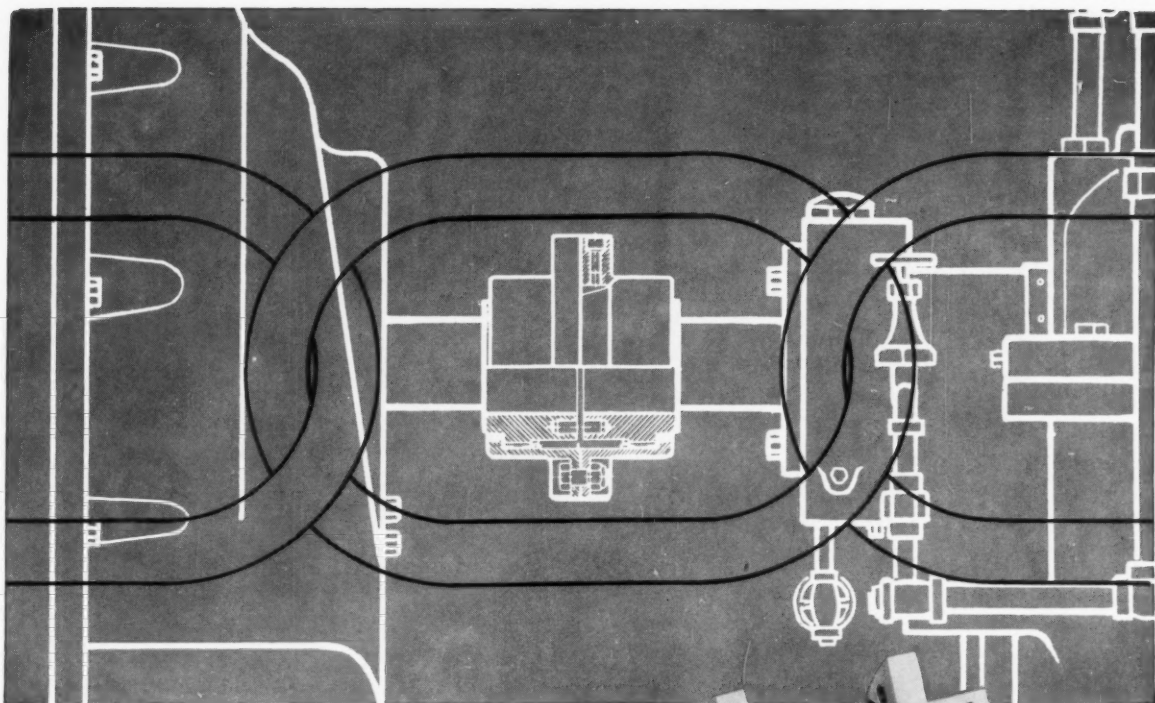
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Factory Engineered Parts—
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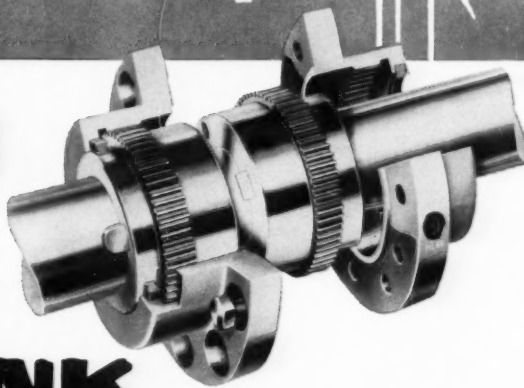


GM "4-71" Diesels provide power for propulsion and operation of Ingersoll-Rand compressors on Matisa Tie Tampers used by C&O Railroad.



FOR WELL-DESIGNED EQUIPMENT...

SPECIFY THIS POWER LINK



When a lot of time and effort have gone into the design of a piece of driven equipment, it makes sense to pick the power link carefully. Take a pump or compressor, for instance. No matter how well it is designed and built, for long service life and operating efficiency, it needs protection against strains due to misalignment.

Waldron gear couplings provide complete protection and positive, trouble-free drive because

They are strong . . . Hubs and cover sleeves for sizes 1 $\frac{1}{4}$ A through 7A are machined from tough steel forgings. Hubs are keyed to the shafts. The two one-piece cover sleeves function as a single, rigid unit serving as a

floating connecting link between the hubs. High strength of forgings makes possible a very compact coupling with low rotating inertia.

They are reliable . . . There are no flexible parts to bend or break and the coupling is dust, moisture, and oil tight. Patented Walflex seal is at the lowest possible diameter where centrifugal force is least. Clearance between teeth in hubs and sleeve is engineered so that an oil wedge always separates them, taking the wear.

They are available . . . Plenty of rough bore couplings, already assembled—on the shelf for *immediate* delivery. Finish bored standard couplings shipped to meet customers' schedules. We are geared up to give you realistic delivery on *any* type of couplings.

Ask for Catalog 57

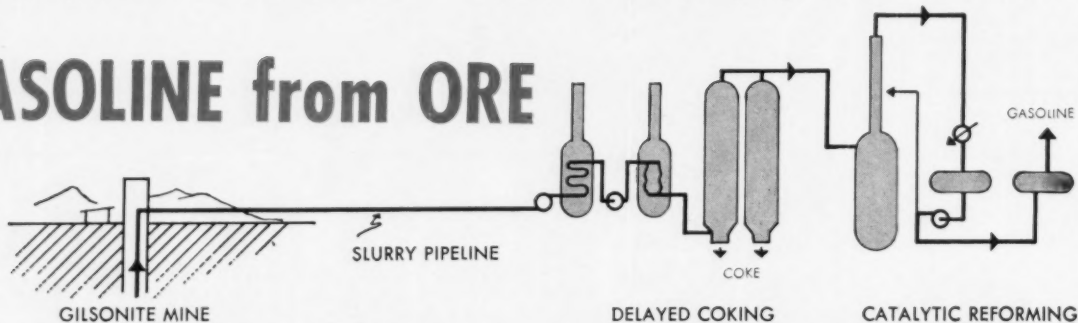
JOHN WALDRON CORP.

A unit of J. O. Ross Engineering Division, Midland-Ross Corporation

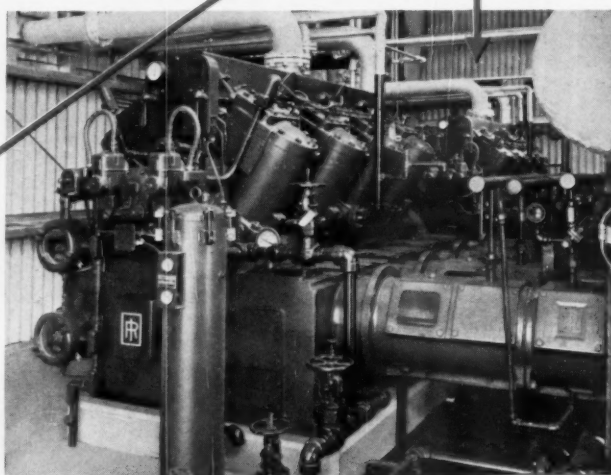
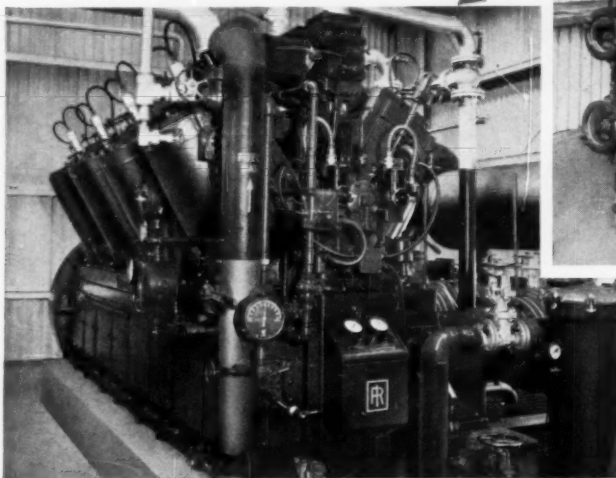
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American Gilsonite's new refinery extracts GASOLINE from ORE



*Ingersoll-Rand SVG and JVG
gas-engine compressors
serve new process*



- ▲ Two Ingersoll-Rand 220-hp JVG-NL gas-engine compressors handling pure hydrogen for the catalytic reformer unit of the Gilsonite plant. The hydrogen is kept free from oil contamination by use of non-lubricated compressor cylinders with Ingersoll-Rand NL Channel Valves.
- ▲ One of two Ingersoll-Rand 550-hp SVG 4-cycle gas-engine compressors handling hydrocarbon gas in the delayed coking section.

They're mining gasoline ore in Utah these days, and an old company in a new refinery is producing new products from it.


In addition to high-octane gasoline, the American Gilsonite Company* at Gilsonite, Colo., is producing high-purity electrode coke from this asphaltite ore. This ultra-modern coking and reforming plant is the nation's first to produce gasoline economically from a raw material other than crude oil, and it's doing it at the rate of 54,600 gallons a day!

Gas compression is required in both the delayed coking and catalytic reforming units, and since by-product hydrocarbon gases were available,

* An affiliate of Barber Oil Corp. and Standard Oil Co. of Calif.

Ingersoll-Rand gas-engine compressors were a natural selection for both jobs. The coke-producing unit, engineered by Foster Wheeler, uses two 550-hp SVG compressors; the refining unit, engineered by H. K. Ferguson, is served by two 220-hp JVG non-lubricated compressors.

In this new service as in all process plant applications, service-proved dependability and smooth operation over a wide range of speeds and loads make Ingersoll-Rand 4-cycle V-angle gas-engine compressors a profitable, long-term investment. Ask your I-R representative for more information about these and other types of equipment for petrochemical and process plants.

Only  compressors have CHANNEL VALVES

Known for high efficiency, quiet operation and exceptional durability. Entirely different. Each valve is a combination of straight-lifting stainless-steel channels and leaf springs, with trapped-air spaces which cushion action, prevent impact.

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At the North Jersey Quarry Co., Summit, N.J., a Bucyrus-Erie 4½-yd. 110-B loads out blasted rock for hauling to crusher.

PROFITABLE EXPERIENCE

brings customers back for more

When final operating figures are tallied, it's the Bucyrus-Erie that produces more at less cost per ton . . . makes repeat buyers of customer after customer.

There are good reasons why Bucyrus-Eries give this kind of performance. Bucyrus-Erie-improved Ward Leonard controls have revolutionized shovel operation by giving operators immediate extra torque to meet every load, faster acceleration and deceleration on every move. Their consistency has been job-proved. They require little maintenance.

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187L58



Typical of K-30 application is this two-piece sealing ring design with K-30 outer ring and cast iron or stainless steel inner.

Licks tough ring problems

Proven Applications

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- ★ Rotary Shaft Seals: corrosive and non-corrosive surface.
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Koppers K-30 piston, wear and sealing rings may be made in all widths and diameters—for use with cast iron, stainless steel, aluminum or chromium-plated cylinders.

Radical, rugged Koppers K-30 gives you new operating economy and long-lived performance in applications too tough for ordinary piston and sealing ring materials. K-30, a special compound of TEFLON* with other wear-resisting materials, features:

- ★ *Low friction coefficient*—inhibits ring wear.
- ★ *Self-lubrication*—reduces cylinder wear.
- ★ *Zero water absorption*—means that it cannot swell or change its shape.
- ★ *Temperature resistance*—from a molecular structure that permits operation at temperatures from -350°F. to 500°F.
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- ★ *Chemical inertness*—makes K-30 corrosion-proof.

If you have a ring problem, put Koppers to work on it. Contact your nearest Koppers Representative or write KOPPERS COMPANY, INC., Piston Ring and Seal Dept., 1608 Scott St., Baltimore 3, Md.

*TEFLON—trademark of E. I. DuPont de Nemours & Co. for tetrafluoroethylene resin.



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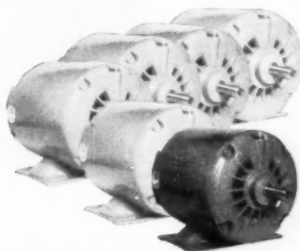
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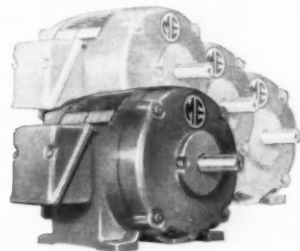
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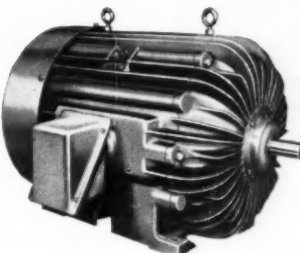
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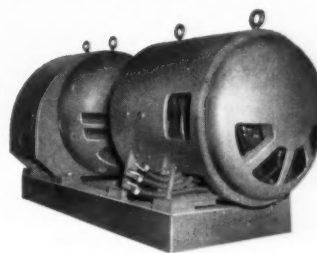
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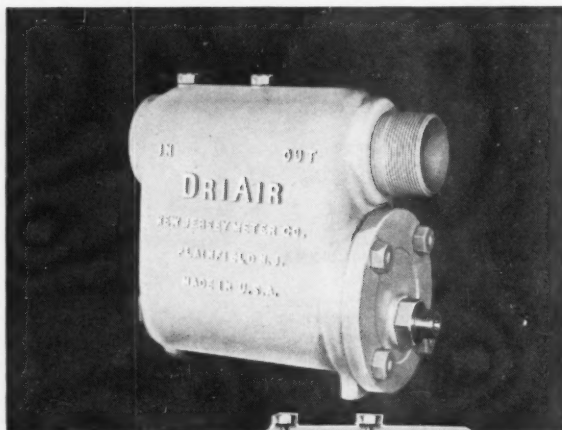
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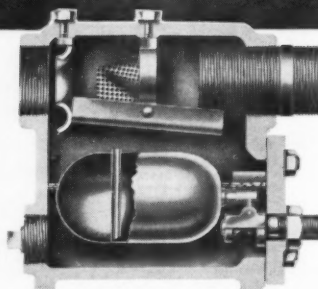
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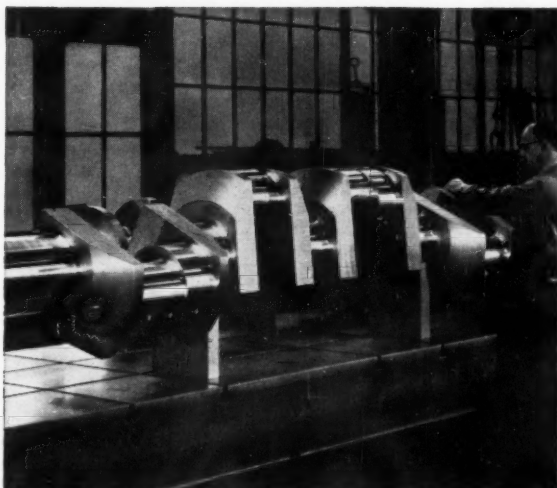


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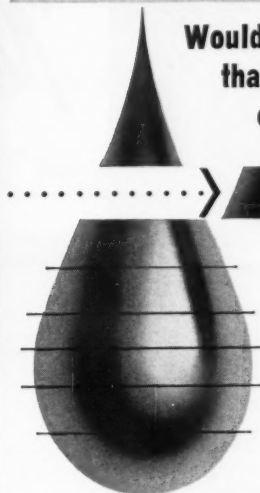
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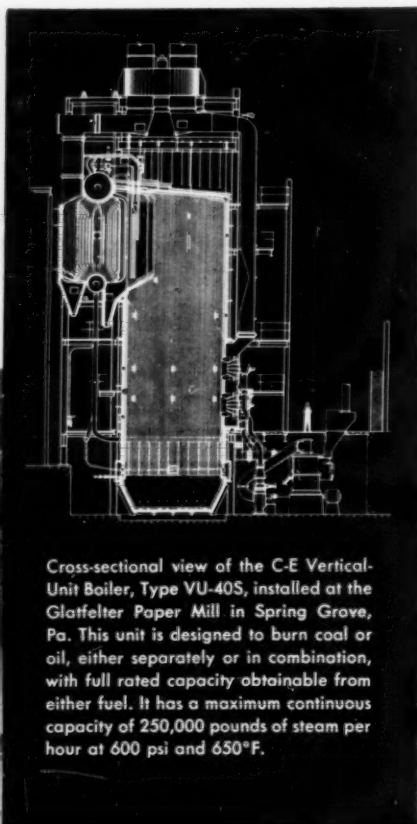
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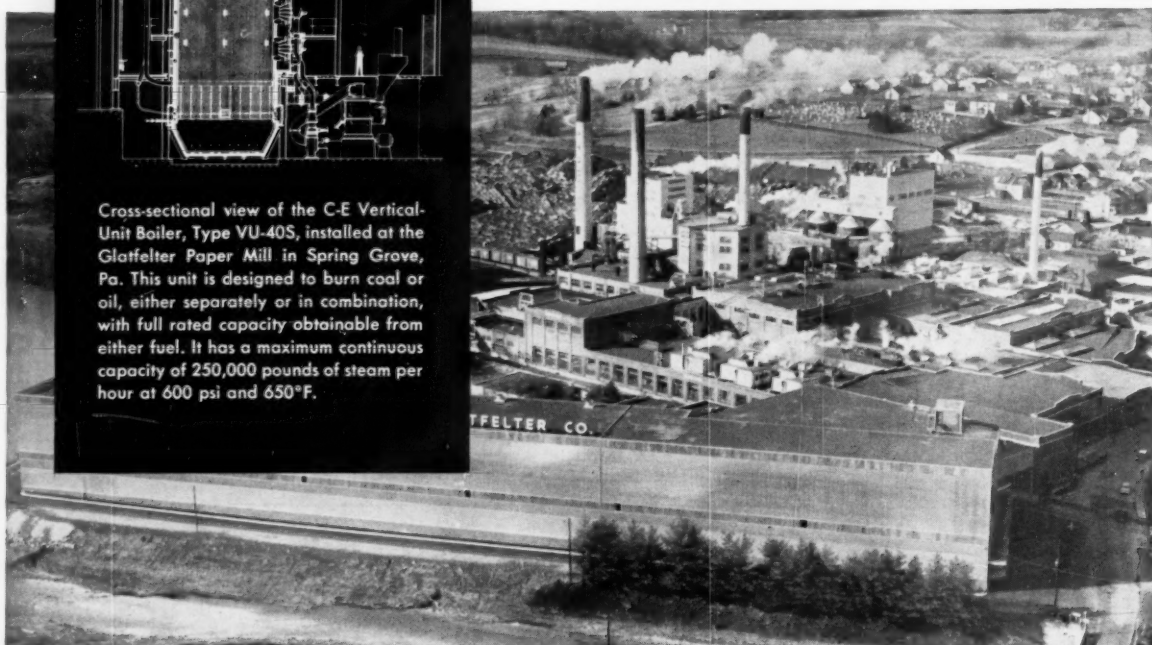
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Cross-sectional view of the C-E Vertical-Unit Boiler, Type VU-40S, installed at the Glatfelter Paper Mill in Spring Grove, Pa. This unit is designed to burn coal or oil, either separately or in combination, with full rated capacity obtainable from either fuel. It has a maximum continuous capacity of 250,000 pounds of steam per hour at 600 psi and 650°F.

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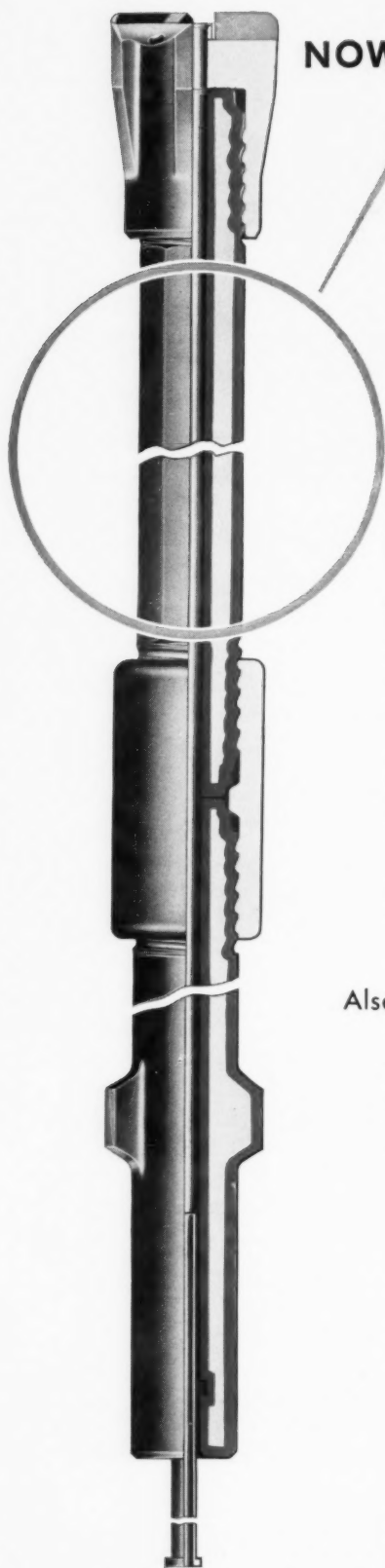
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		2⅛"	1	5
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